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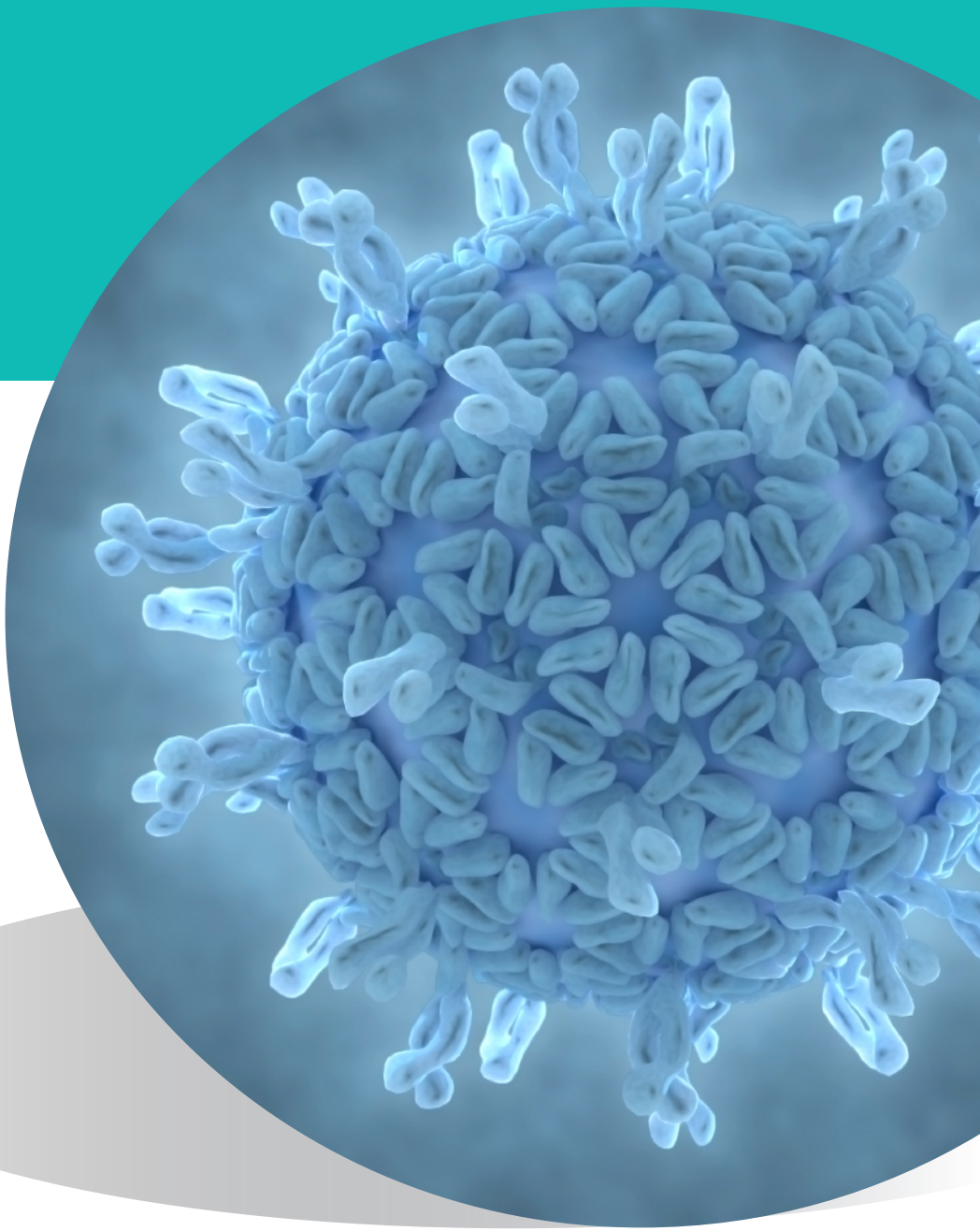
# Infectious Diseases in Finland 2015

REPORT



15 | 2016

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# Infectious Diseases in Finland 2015

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In addition to commentary, the report includes figures and tables that are not employed in our regular reporting. Distributions by gender, age and region are available on our website. The figures for some of the diseases in the National Infectious Diseases Register (NIDR) will still be updated after being published in the online publication. Up-to-date figures are available at http://tartuntatautirekisteri.fi/tilastot

Cover image: Shutterstock

Layout: Laura Pentikäinen

Infectious Diseases in Finland 2015.

National Institute for Health and Welfare, Report 15/2016

ISBN (online) 978-952-302-710-7
ISSN (online) 1798-0089
http://urn.fi/URN:ISBN:978-952-302-710-7

# Contents

# Introduction

The infectious disease situation differed from that of previous years, both at home and abroad. The exceptionally long influenza season affecting a large number of people in Finland, the vast numbers of asylum seekers arriving in Europe, and the Zika virus – transmitted by mosquitoes and spreading in Brazil – posed new challenges for the prevention of communicable diseases.

The dominant virus of the exceptionally long 2014–2015 influenza season was an A(H3N2) subtype, infecting the people over 75 years in particular. A record number of cases caused by influenza virus B were reported and – simultaneously with influenza A – cases abounded throughout the season.

In March–May, an epidemic caused by the bacterium *Salmonella* Enteritidis affected almost 100 tourists who had visited Latvia. The epidemic was related to junior ice hockey tournaments organised in Riga. It is likely that cases occurred even among ice hockey players in Sweden and Norway. The European Centre for Disease Prevention and Control (ECDC) coordinated the investigation of the epidemic. The cause for the increasing number of campylobacter infections in 2014 and 2015 remains unknown. More information on the country of origin and sources of campylobacter infections would be necessary in order to target prevention measures. Yet another epidemic was linked to the consumption of unprocessed milk. In Raseborg, 19 people contracted *Campylobacter jejuni* gastroenteritis, which was accompanied by a fever. Since up to 60% per cent of rotavirus infections were diagnosed in the over 5 age group, it seems that the vaccine protects younger children fairly well.

The increasing number of Hepatitis A infections diagnosed within a three-year period is linked to extensive international food-borne epidemics. The number of sexually transmitted diseases has remained unchanged, except for syphilis, which has increased in the last two years. In the last ten years, the number of HIV cases has remained almost unchanged and the risk of sexually transmitted HIV infections has almost been eliminated, owing to modern treatment.

Thankfully, the number of MRSA infections was slightly lower than in the previous year, although a previously rare strain of MRSA CC398, linked to production animals, was detected in 41 individuals in Finland. The number of CPE findings doubled over 2014. Approximately one half of CPE infections had been acquired abroad. Increasing antimicrobial resistance poses one of the most serious threats to modern medicine.

The percentage of tuberculosis cases among foreign nationals increased by one fifth over the previous year, being as high as 39% in 2015. The growing numbers of asylum seekers were probably one of the contributing factors to this trend. The number of drug-resistant *Mycobacterium tuberculosis* strains has also increased slightly in recent years.

There was a continuous increase in bacterial findings in adults' blood culture samples, particularly in patients aged 65 or over. *Escherichia coli* was the most common finding both in the working age population and in patients aged 65 and older. Other common findings include *Staphylococcus aureus*, a significant percentage of which is known to consist of treatment-related infections.

The incidence of serotypes not included in the pneumococcal conjugate vaccine increased; in patients aged 65 or older, 80% of cases were caused by serotypes not included in the vaccine. The ageing of the population and possible changes in disease diagnostics and the prevalence of the risk factors of pneumococcal disease may be contributing to this increase. Record numbers of borrelia and TBE infections, transmitted by ticks, were identified, the latter mainly occurring in known risk areas. Ticks may be becoming more widespread due to global warming and potential new areas of infection include Porkkala, Oulu, Ilomantsi, Muurame, the Rauma archipelago and Vierumäki.

The reform of the Communicable Diseases Act progressed to the committee reading stage. Unfortunately – and unexpectedly at this stage – a small group of actors began to demand restrictions to the authorisations specified in the Act for implementing measures essential to the prevention of infections, including for persons without right of abode, contrary to the stand taken by the majority of infectious disease experts, the National Institute for Health and

Welfare THL, and almost the entire working group when preparing the legal reform. If realised, this change would considerably undermine the preconditions for preventing infectious diseases and possibly result in Finland being in breach of its international obligations.

## International situation

The previous year, 2014, was characterised by the international public health emergency caused by the Ebola epidemic in West Africa. During 2015, however, an extensive international aid operation managed to gain control of the situation and the number of cases fell to almost zero in Guinea, Sierra Leone and Liberia. In response, the WHO declared an end to the Ebola-related public health emergency in 2016.

An extensive, continuously spreading epidemic caused by the Zika virus, which is transmitted by mosquitoes, was detected in South and Central America in 2015. An infection contracted during pregnancy seems to cause congenital neurological disorders, including microcephaly, in the foetus. An increased risk of Guillain-Barré syndrome, with symptoms of paralysis, has also been observed in infected individuals. Due to the scope of the epidemic and the related birth defects, the WHO declared another international public health emergency in 2016. It is not possible for the Zika virus to become endemic in Finland because the virus-transmitting mosquitoes would not survive in our climate.

## Increasing number of asylum seekers

Migration due to the civil war in Syria and the expanding activities of the terrorist organisation Isis was a major development affecting the entire EU area in 2015. According to statistics compiled by the Finnish Immigration Service, more than 30,000 asylum seekers arrived in Finland in 2015. The number of reception units increased from 28 to 212.

Although the majority of the asylum seekers are healthy young men, there are families with children and elderly people whose state of health is not always good. They may have been exposed to communicable diseases in refugee camps or during their journey and their immunisation may be deficient due to the unstable conditions in the areas they have fled. In 2009, the Ministry of Social Affairs and Health issued the guidelines “Prevention of infection problems among refugees and asylum seekers”, on the basis of which reception centres governed by the Finnish Immigration Service were responsible for assessing the risks of infection among immigrants.

On several occasions during the year, as the reception of asylum seekers became congested, the Ministry of Social Affairs and Health asked the National Institute for Health and Welfare (THL) for comments on the prioritisation of the measures described in the guidelines, based on international recommendations (by the WHO and ECDC), and the development of the situation. Within the collaboration agreement between the authorities, concluded by THL with the Finnish Immigration Service (MIGRI), THL provided MIGRI with the services of the Medical Specialists. MIGRI has outsourced its reception centre services, including health care, to several actors. In its health care activities, MIGRI cooperates with a range of municipal health centres and specialised medical care providers. THL's Medical Specialists allocated a great deal of time to supporting this cooperation.

The higher number of asylum seekers was clearly visible in the number of cases of some infectious diseases subject to screening. Outbreaks of chickenpox occurred in some reception centres and diphtheria was diagnosed in Finland – for the first time in decades – in a young asylum seeker. The number of cases reported to the National Infectious Diseases Register (NIDR) without a Finnish identity code increased for hepatitis B, syphilis, MRSA, ESBL-*E.coli* and -*K.pneumoniae*, but not for HIV. This may be partly related to asylum seekers, but no precise information is available in this respect, because the report to the NIDR does not specify whether the infected person is an asylum seeker. The guidelines of the Ministry of Social Affairs and Health state that the purpose of examination for infectious diseases is to protect not only the individual's personal health, but also to break chains of infection in order to protect everyone residing in Finland.

Preliminary information indicates that differences in interpretation in various parts of the country hampered the implementation of the Ministry of Social Affairs and Health guidelines. In two regions, the Regional State Administrative Agency issued specific interpretations of its own on how to apply the guidelines which were not in line with the recom-

mendations of the Association of Finnish Local and Regional Authorities and the Ministry of Social Affairs and Health. As a consequence, approximately one third of the asylum seekers were not examined for all infections as recommended nor they receive all recommended vaccinations. In other regions, the examinations and vaccinations were implemented commendably well.

Helsinki, 3 June 2016

Mika Salminen
Head of Department
Department of Infectious Disease Surveillance and Control

# Respiratory infections

- The 2014–2015 influenza season was exceptionally long.
- The dominant virus was an A(H3N2) subtype, infecting the over 75 age group in particular.
- A record number of cases of influenza B virus were reported and infections abounded – simultaneously with influenza A – throughout the season.
- As before, the influenza vaccination coverage rate remained low.
- The customary increase in the number of rhinovirus cases was detected in the autumn and spring, with more than half of the infections diagnosed in children under the age of 4.
- As expected, the major RSV winter epidemic of 2014 was followed by a minor epidemic that began in January 2015 and continued until July.
- Of legionellosis infections, the sources of six cases of infection contracted in the home country were examined more closely through water samples, and Legionella bacteria were detected in two residential buildings.

## ADENOVIRUS

In 2015, 1,134 confirmed cases of adenovirus infection were recorded (2014: 1,004). The largest number of cases occurred in the under 5 age group (more than 500), but numerous cases were also diagnosed in the 5 to 9, 15 to 19 and 20 to 24 age groups. In February–April and October–November 2015, slightly more adenovirus infections were reported than in the other months (100–128 cases per month). At other times of the year, the monthly number of adenoviruses was almost the same (66–89 cases per month).

More than 50 types of adenovirus are known. Some cause respiratory infections, while others cause gastrointestinal, eye or other infections. Adenoviruses are common pathogens in infants and small children; they rarely occur in adults.

Laboratories have various test methods for detecting adenoviruses in clinical samples. Antigen detection, virus cultures and PCR are sensitive and reliable methods used in specialised virus laboratories.

## INFLUENZA

The 2015 winter epidemic season began earlier than usual, in December 2014, and continued until the end of May. Viruses of the influenza A(H3N2) subtype and influenza B emerged as the epidemic dominant virus in the 2014−2015 season. Only individual cases of influenza A(H1N1)pdm09 infections were detected during the season.

### Influenza A

In 2015, 7,701 findings of influenza A were reported to the National Infectious Diseases Register, more than in the previous year (2014: 6,364). The first cases of influenza A infections in the 2014–2015 season were reported to the National Infectious Diseases Register in October–November 2014. The number of findings increased after mid-November 2014. National surveillance of influenza virus infections by the National Institute for Health and Welfare led to the detection of 100 influenza A infections during the season 2014–2015, of which 97% were diagnosed as having been caused by the influenza A(H3N2) virus. Only individual cases of influenza A(H1N1)pdm09 infections were detected during the season.

Data in the National Infectious Diseases Register and from the national influenza surveillance of the National Institute for Health and Welfare indicate that the epidemic season of influenza A peaked in February, duringweeks 5 to 9. The 2014–2015 epidemic season proved exceptionally long as the numbers of reported influenza A findings remained rela-

tively high for weeks. The number of cases did not decline until in late May to early June. After that, only isolated cases of influenza A were detected. The number of influenza A cases began to increase again after mid-November 2015, which indicated an exceptionally early start to the season in 2015–2016.

Influenza A infections were found in all age groups, but unlike the previous year, in the over 75 age group in particular (2015: 1,715 cf. 2014: 614). Reasons for the high morbidity in the 75 age group may include the abundant incidence of influenza A(H3N2) viruses and the antigenic difference between these viruses and the vaccine virus. The number of severe infections among the aged is known to be higher than in other age groups during influenza A(H3N2) virus seasons, which may also be reflected in the higher number of findings among older age groups.

Although the national influenza vaccination programme has offered a seasonal influenza vaccination for medical reasons, free of charge, for children in high-risk groups since 1980, and for healthy children aged 6 to 35 months since 2007, influenza vaccination coverage has remained low. Before the pandemic, coverage among children aged 6 to 35 months was around 40% at best. After the pandemic, vaccination coverage among young children was around 13% at the lowest point whereas it was slightly better, at around 17%, during the 2014–2015 season. In 2015, the highest number of influenza A cases among the age groups including children and young people were reported in the 0 to 4 age group (724).

In spring 2014, after the WHO's vaccine recommendation for the northern hemisphere for the epidemic season 2014–2015, new types of A(H3N2) viruses were detected that were antigenically different to the vaccine virus. During the summer and autumn of 2014, these spread into the southern hemisphere and were almost solely responsible for the influenza A epidemic in the northern hemisphere in the winter of 2015.

Although the diversity of influenza A(H1N1)pdm09 viruses has increased since their appearance, the epidemic viruses of winter 2015 were antigenically similar to the vaccine virus (A/California/07/2009).

Towards the end of 2015, as the number of influenza A cases began to rise again, A(H1N1)pdm09 viruses emerged, in turn, as the dominant virus.

### Influenza B

In 2015, a record number of influenza B cases were reported to the National Infectious Diseases Register, 5,482 (2014: 778). The previous significant influenza B epidemic occurred in 2011, with 3,433 cases of influenza B recorded. In the epidemic season 2014–2015, the number of influenza B infections began to rise early, from the beginning of December 2014, after which a large number of cases was detected throughout the season, simultaneously with influenza A infections. After March, the weekly number of influenza B findings exceeded that of influenza A. Influenza B infections peaked in February–April, in weeks 7–15. As in the case of influenza A, the number of cases did not decrease until late May to early June. Influenza B infections were diagnosed in all age groups.

Of the two influenza B virus lineages that have circulated the world in recent seasons, the Yamagata lineage has occurred more frequently than the Victoria lineage. The influenza B viruses in circulation during the winter of 2015 almost exclusively represented the Yamagata lineage, with only occasional Victoria lineage viruses being found. The Yamagata viruses that circulated in Finland belonged to a different group genetically and were antigenically somewhat different to the vaccine virus of the same lineage (B/Massachusetts/02/2012).

### Vaccine for the epidemic season 2015–2016

Based on reports of the influenza A and B epidemic viruses circulating the world, the WHO recommended a change to the vaccination composition in the Northern Hemisphere for the epidemic season 2015–2016 for two virus components. The recommendation was that the influenza A(H3N2)virus component be changed to A/Switzerland/9715293/2013, which had a better antigenic correspondence to the transformed A(H3N2) viruses circulating as an epidemic. The influenza A(H1N1)pdm09 component remained unchanged as the A/California/07/2009 virus. The influenza B virus component was changed to B/Phuket/3073/2013, which continued to represent viruses of the Yamagata lineage but dif-

fered antigenically from the influenza B virus component previously used in the vaccine.

## Season 2015–2016

The first cases of influenza A infections were diagnosed in November and December 2015, earlier than usual as in the previous season. The 2015−2016 season began early, in December, after which the number of influenza A infections increased very rapidly. The epidemic began throughout Finland almost simultaneously. Influenza A viruses peaked in January–February. Unlike previous seasons, more than 1,000–2,000 influenza A findings per week were reported during the peak weeks 3–6. The number of influenza B infections began to increase in February.

The influenza A(H1N1)pdm09 viruses, which circulated as the dominant virus of the season, were antigenically similar to the vaccine virus. Influenza B viruses detected by mid-March were of the Victoria lineage and thereby different to the vaccine virus. The occurrence of influenza B viruses of the Victoria lineage increased in Europe during the winter 2016; it is therefore possible that another epidemic wave of influenza B will be experienced later in the spring of 2016.

At the end of February 2016, the WHO issued a new vaccine recommendation for the northern hemisphere 2016–2017 epidemic season, based on the then current epidemic situation. In the new recommendation, the WHO recommended that the influenza A(H1N1)pdm09 component be kept unchanged as the A/California/07/2009 virus, but the influenza A(H3N2) virus component be changed to A/Hong Kong/4801/2014, which is antigenically a better match with the A(H3N2) viruses circulating as epidemics. Due to the increased occurrence of influenza B/Victoria lineage viruses, the WHO recommended the inclusion in the vaccine of the B/Brisbane/60/2008-virus of the Victoria lineage. In addition to the aforementioned viruses, another influenza B virus, B/Phuket/3073/2013 of the Yamagata lineage is recommended for quadrivalent vaccines.

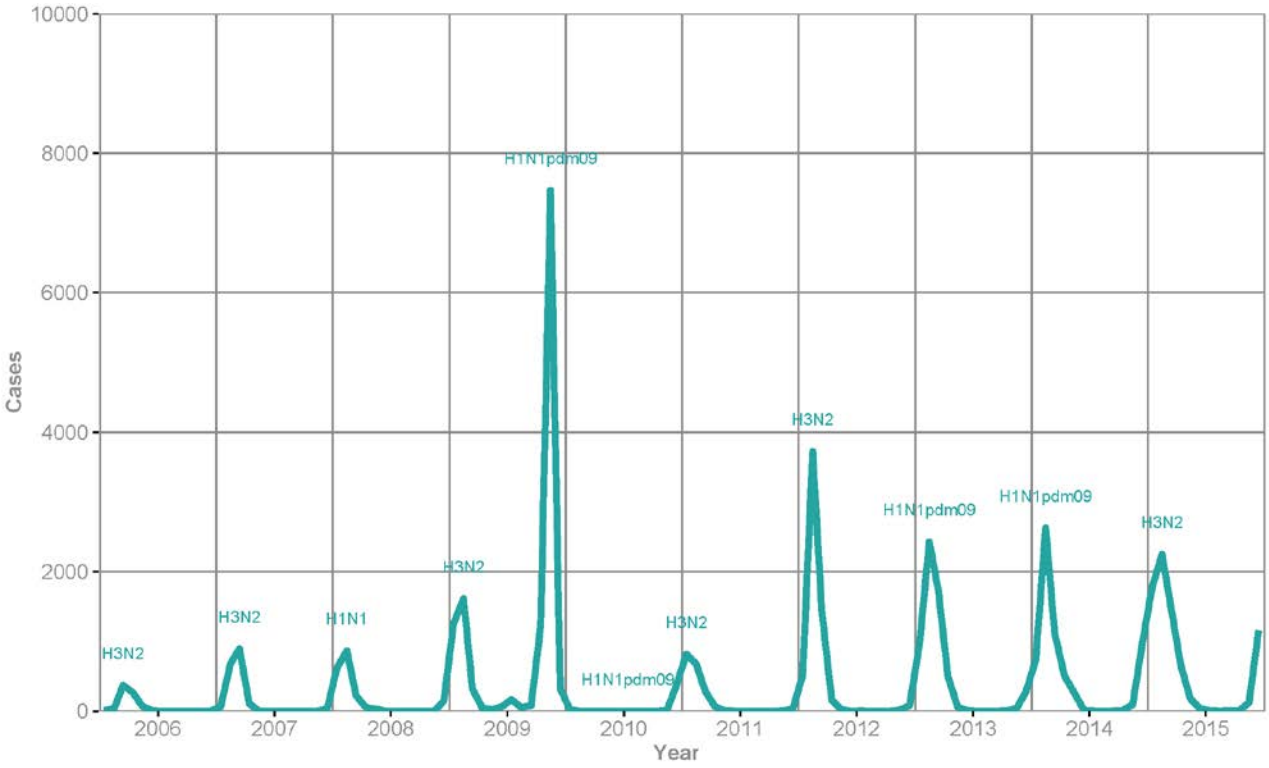


**Figure 1. Cases of influenza A by month, and epidemic virus serotypes, 2006–2015 (no. of cases).**

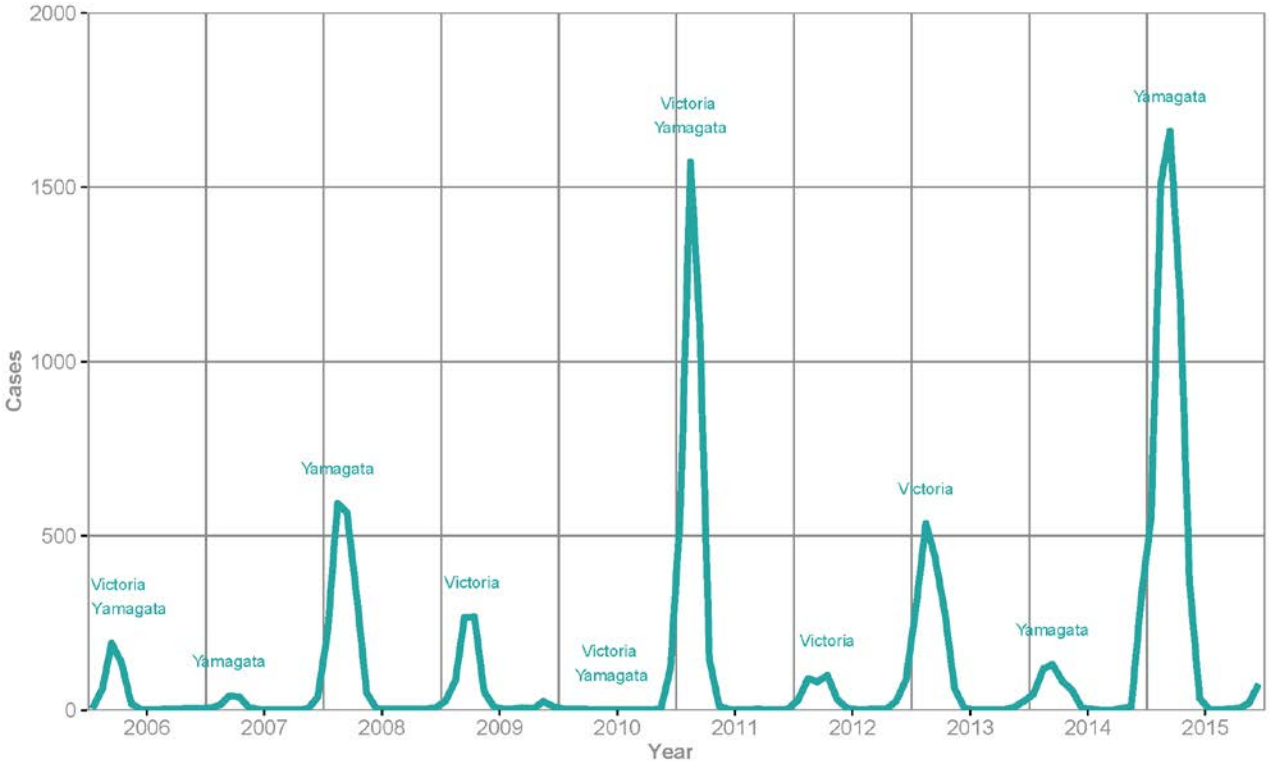


**Figure 2. Cases of influenza B by month, and epidemic virus serotypes, 2006–2015 (no. of cases).**

## PARAINFLUENZA

Parainfluenza viruses are grouped under one heading in the NIDR, even though laboratories usually differentiate between parainfluenza viruses 1, 2, 3 and 4. In 2015, 508 parainfluenza infections were confirmed (2014: 556), most of them in the 0 to 4 age group (234 cases). Based on the number of cases, no separate epidemic peak was detected in 2015, but an almost steady number of parainfluenza cases were reported throughout the year. The months with the highest number of cases (63–67 per month) were February and November–December.

Parainfluenza virus infections are found in patients of all age groups. The first parainfluenza infections in children can lead to a severe condition that may require hospitalisation. In an older child or adult, the symptoms of a parainfluenza infection are typically much milder. They often present as an ordinary upper respiratory tract infection and do not necessarily require laboratory diagnostics. In special groups, however, such as immune deficiency patients, parainfluenza viruses may cause severe symptoms. Almost every year, parainfluenza virus type 3 causes minor epidemics in the summer and autumn, whereas type 1 and 2 viruses do not cause epidemics every year.

## RHINOVIRUS

In 2015, 1,088 confirmed cases of rhinovirus infection were recorded (2014: 728). In 2015, the typical peaks in spring and autumn were detected in the number of rhinovirus infections. The numbers were highest from April to May (111–120 per month) and August to November (109–160 per month), while at other times, rhinovirus infections occurred at a steady rate every month (38–77 per month). More than 50% of these infections were diagnosed in children under the age of 4.

More than 150 types of rhinovirus are known. They are the most common cause of mild respiratory infections. Rhinovirus infections are most common in young children, but are present in all age groups. Since August 2013, rhinoviruses have been included in the surveillance of respiratory virus infections conducted by the National Institute for Health and Welfare (THL), which may partly contribute to the increase in the number of cases from 2013 to 2015. Laboratories use the PCR test to detect rhinoviruses in clinical samples. This test is extremely sensitive

and reliable. Specialised virus laboratories are also able to culture rhinoviruses.

## RSV

In 2015, 2,435 cases of RSV confirmed by laboratory tests were reported to the NIDR (2014: 2,369). On the basis of long-term surveillance, a major RSV epidemic is observed in Finland every other winter, often starting in November–December. In addition, a minor epidemic occurs between the major ones. As expected, the major winter epidemic of 2014 was followed by a minor epidemic that began in January 2015 and continued until July. During the epidemic, the number of RSV cases was highest in February to March (over 300 cases per month). Individual cases of RSV infection were diagnosed during the summer. In November–December, the number of RSV cases began to increase again, indicating the start of another RSV epidemic.

The majority of RSV cases (almost 80%) were found in children aged 0 to 4. Slightly more cases of RSV were reported in the over 75 than in other age groups. Although RSV infections are present in all age groups, cases requiring hospitalisation and laboratory diagnostics mainly involve infants and small children.

Reliable quick tests for RSV diagnostics have been developed for use at health centres, outpatient clinics and hospitals. In hospital conditions, RSV is easily transmitted between patients. Quick tests make it easier to identify RSV infections and therefore to prevent further transmission. Specialised virus laboratories increasingly use genetic replication methods for diagnosing RSV.

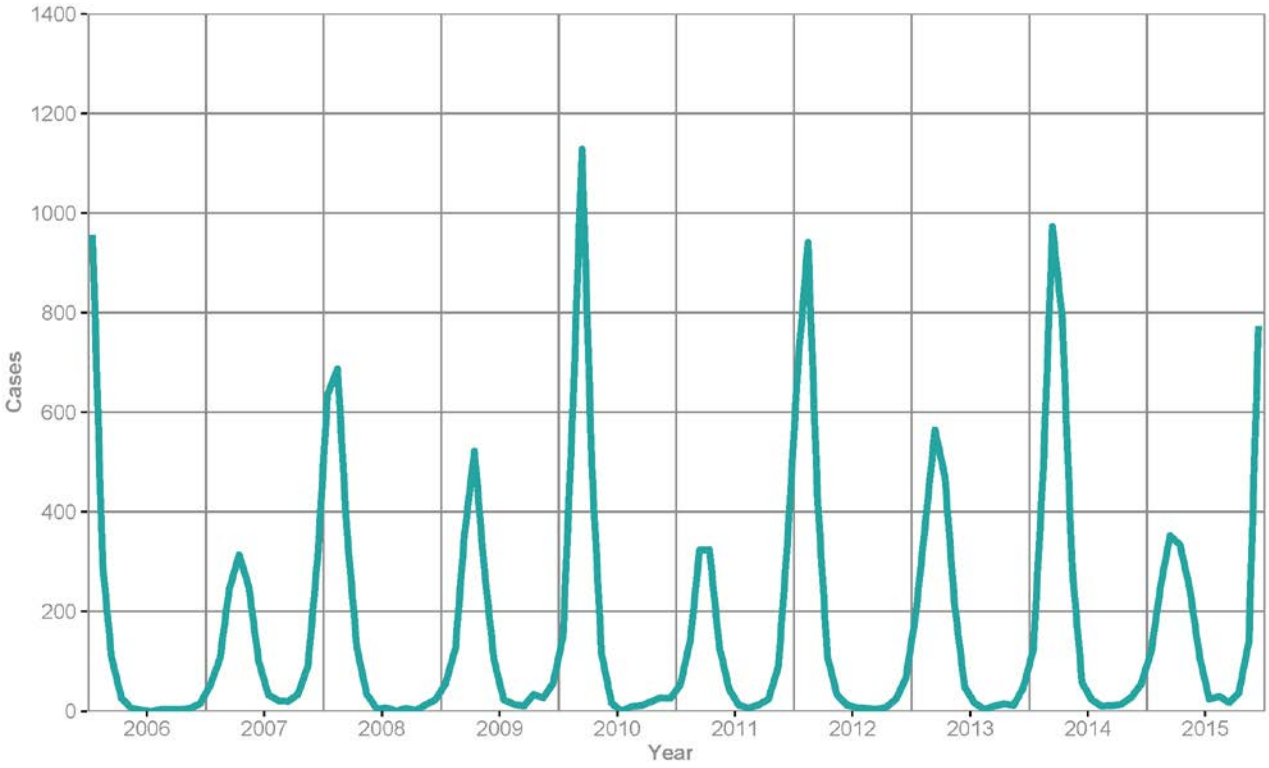


**Figure 3. Cases of RSV by month, 2006–2015 (no. of cases).**

## ENTEROVIRUS

In 2015, 119 cases of enterovirus infection were reported to the National Infectious Diseases Register, considerably less than in 2014 (298) or 2013 (184). Most cases were found in the autumn, with 71% being diagnosed in August–December.

In autumn 2014, severe cases of respiratory infection were caused by the type D68 (EV-D68) enterovirus in the United States and Canada. Most of the affected patients were children who required hospitalisation, particularly among asthma sufferers. EV-D68 was also identified in a few patients who developed polio-like paralysis symptoms after the respiratory infection. In Finland, EV-D68 was diagnosed in some 20 patients with a respiratory infection in the autumn 2014, and in individual patients even in 2015. No serious cases of illness or neurological symptoms appeared. Respiratory infections caused by EV-D68 were diagnosed in most European countries, but no widespread epidemics have been reported.

Enteroviruses cause not only upper respiratory tract infections but conditions such as meningitis, myocarditis, hand, foot and mouth disease and other types of eczema. PCR methods have increasingly replaced traditional virus cultures in enterovirus diagnostics. Virus typing is performed on the basis of molecular genetics or antibodies.

## WHOOPING COUGH

In 2015, the number of whooping cough cases reported to the NIDR totalled 165 (3.02/100,000), slightly fewer than in 2014 (205; 3.8/100,000). As before, the cases were most common in the 0 to 14 age group, with eleven cases in patients under 12 months of age and six of them under 3 months of age, i.e. under the age of vaccination. The diagnosis of patients aged under 12 months was principally based on a PCR test (10; 91%) and for most patients of other ages, the diagnosis was made on the basis of antibody testing (142; 92%).

Of the children 3 to 23 months of age who contracted whooping cough and whose vaccination data was available, four had not been vaccinated while others had received 1–3 doses of vaccine containing acellular component of pertussis. In 2015, of the five *Bordetella pertussis* strains isolated, two did not produce pertactin.

As previously, the incidence of whooping cough varied considerably by hospital district (0–15.9/100,000). The incidence was highest in the Hospital District of East Savo, while no cases were diagnosed in the Hospital Districts of Åland, Kainuu, Keski-Pohja and Länsi-Pohja.

Choosing an optimum vaccination strategy for whooping cough is challenging, as the acellular vaccines widely used in the western countries are incomplete in terms of their efficiency and duration. A booster for six-year-olds was added to the national vaccination programme in Finland in 2003. In 2005, the whole-cell vaccine was replaced with acellular combination vaccine containing the Bordetella pertussis antigen for children in the age groups covered by child care clinics. Until 2007, adolescent vaccinations were given between the ages of 11 and 13. Since 2009, the recommendation has been to vaccinate adolescents at the age of 14 to 15, i.e. beginning in the 8$^{th}$ grade of comprehensive school. Due to this transition, very few of these vaccinations were administered between 2009 and 2011. This created a temporarily less well protected cohort in adolescent age groups. Illness in infancy indicates insufficient herd immunity. A whooping cough vaccine for conscripts beginning their military service was added to the Finnish Defence Forces' vaccination programme in summer 2012.

So far, Finland has been spared the extensive whooping cough epidemic that generated more than 40,000 cases in the United States and almost 10,000 cases in the UK during 2012. In 2012, the year the epidemic occurred, on the basis of an extensive strain collection in the United States it was discovered that 60% of *B. pertussis* strains did not produce pertactin. Both countries initiated a whooping cough vaccination campaign for pregnant women, resulting in a significant reduction in the number of whooping cough cases in young infants. With respect to Finland’s neighbouring countries, in Sweden the number of whooping cough cases almost tripled in 2014 and remained high in 2015 (at some 600 cases). Other EU Member States with a high incidence of whooping cough (>10/100,000) in 2014 included Norway, Denmark, Germany, Belgium, the Netherlands, Czech Republic, Slovenia and Slovakia.

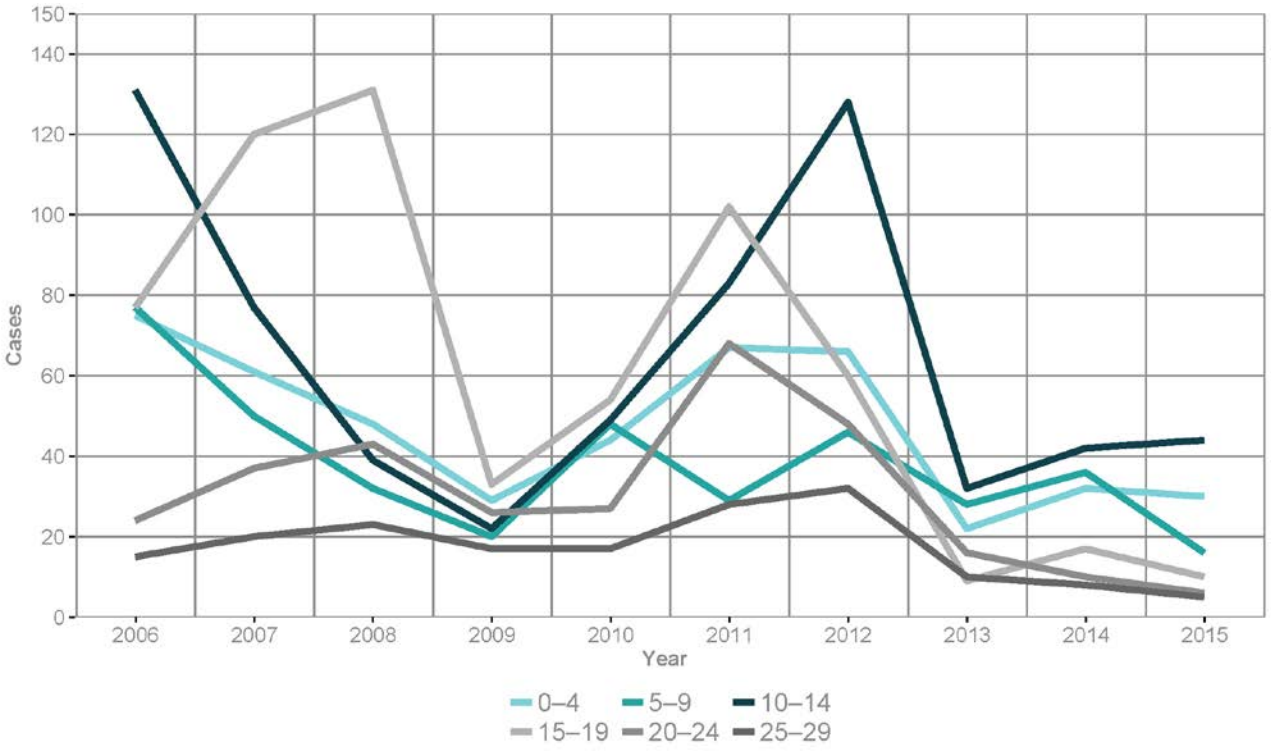


**Figure 4. Cases of whooping cough in children's and young adults' age groups, 2006–2015 (no. of cases).**

## CHLAMYDIA PNEUMONIAE

In 2015, 285 cases of *Chlamydia pneumoniae* were reported based on laboratory verification, mainly antibody testing. The figure was slightly higher than in the previous year. The highest incidence was reported in the hospital districts of Vaasa, South Ostrobothnia and East Savo, while the number of cases was highest in the Helsinki and Uusimaa Hospital District (91). The number of reported infections was highest among 5 to 24-year-olds, but cases can be found in all age groups.

## LEGIONELLA

In 2015, 22 cases of legionellosis were reported to the National Infectious Diseases Register, of which 16 were based on the detection of the antigen in urine, one on a PCR test of sputum, and five on serological methods. Further investigation revealed that the clinical presentation was consistent with legionellosis in 17 cases, whose chest X-ray revealed changes indicative of pneumonia. The average age of patients was 61 (variation 50–74) and 12 (71%) of them were male.

Ten (59%) individuals had contracted the infection while travelling abroad, seven in Finland. The sources of six cases of infection contracted in the home country were examined more closely through water samples, and Legionella bacteria were detected in two residential buildings. Two patients had been infected in the same premises. *L. pneumophila* bacteria serotype 1 (15,000 cfu/l) and other types of legionella (76,000 cfu/l) were detected in the residence of one of the patients, alongside a high count of legionella bacteria in other samples taken on the premises (up to a total of 230,180 cfu/l). Cleaning measures, including chlorination and raising the temperature, succeeded in reducing the count of legionella bacteria below the threshold at which measures are necessary. On the other premises, where one person had been infected, *Legionella pneumophila* bacteria of serotype 1 were found in cold household water (230,000 cfu/l, cold water temperature 30°C). Legionella bacteria were even present in other water samples taken in the same block of flats and in the hot water supply. Monitoring continues on the premises and samples will be taken after the completion of cleaning measures.

Samples taken at the homes and workplaces of three other patients did not reveal the source of infection.

According to the European guideline for legionella, the threshold for measures requiring the cleaning of the cold and hot household water supply is >1,000 cfu/l of legionella. The common factor for both premises was that water temperatures did not comply with recommendations. This facilitated the growth of legionellas in the water supply systems. According to the National Building Code of Finland, section D1, the hot water temperature must be 55–65°C and the recommended maximum temperature of cold household water is 20°C.

Accommodation data relating to all of the patients who fell ill abroad was reported to the ELDSNET database (European Legionnaires' Disease Surveillance Network), which collects data on travel-related cases of legionellosis. European surveillance indicates that the majority (around 60–70%) of cases are of community origin, some 20% are associated with travel and fewer than 10% originate in hospitals. In Finland, cases of legionellosis are traditionally linked with travel. Legionella is therefore often overlooked as the potential pathogen in pneumonia cases of domestic origin. In 2011–2013, 77–100% of cases of legionellosis in Finland were travel-linked but in 2014, only 20% were, which was slightly exceptional.

## MYCOPLASMA PNEUMONIAE

In 2015, the total number of *Mycoplasma pneumoniae* cases confirmed in laboratory tests was 1,671, lower than in the previous years. During the previous epidemic in 2012, the number of cases exceeded 4,600 and in 2011 the total was over 7,800. We seem to be experiencing a period between epidemics and two or three years remain before a new winter epidemic occurs.

The highest number of *M. pneumoniae* cases are diagnosed in the 5 to 19 age group. As in previous years, the majority of cases (almost 500) were recorded in the Helsinki and Uusimaa Hospital District. The incidence was still highest in the Hospital District of East Savo (70/100,000).

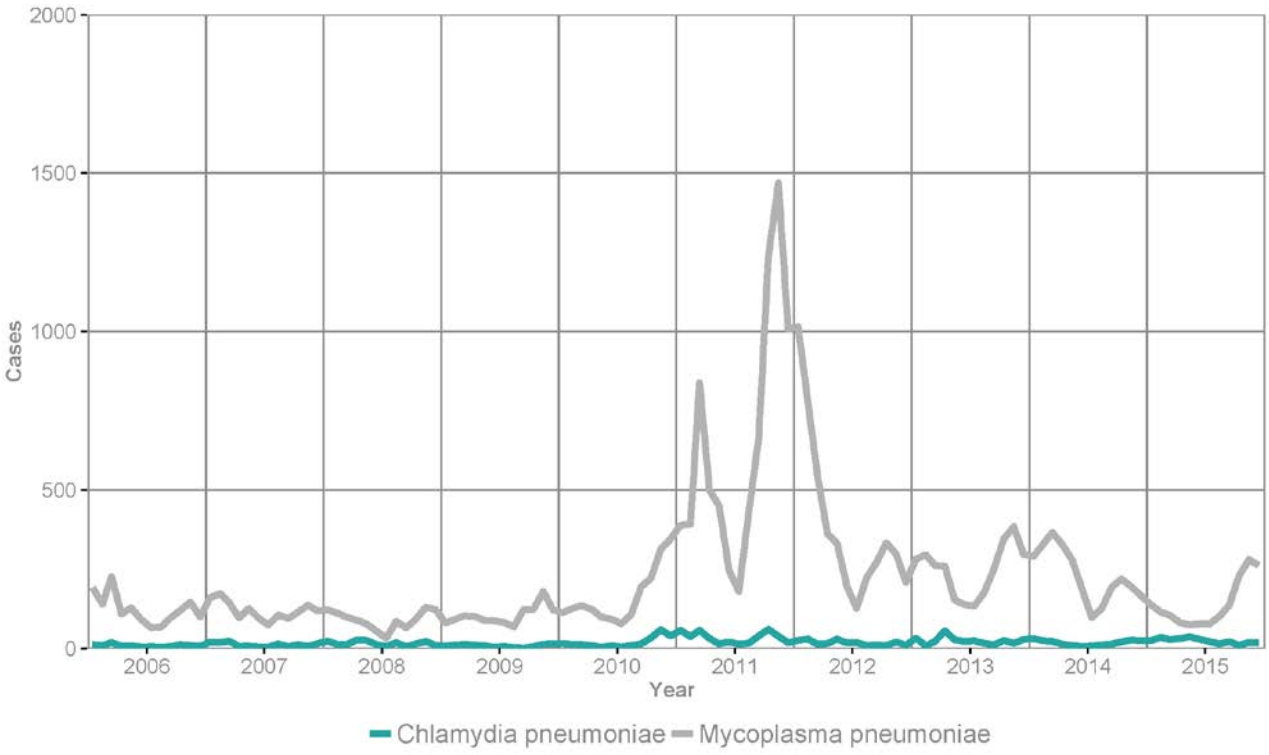


**Figure 5. Cases of Mycoplasma pneumoniae and Chlamydia pneumoniae by month, 2006–2015 (no. of cases).**

# Gastrointestinal infections

- In March–May almost 100 tourists who had visited Latvia contracted an infection caused by the *Salmonella enteritidis* bacterium. The outbreak was detected when three individuals were hospitalised due to gastrointestinal symptoms after participating in an ice hockey tournament in Riga.
- In April, 19 people contracted gastroenteritis accompanied by a fever after visiting a cowshed. Some of them had consumed unprocessed milk on the farm. Laboratory tests confirmed that the bacterium *Campylobacter jejuni* was the pathogen.
- The number of *Clostridium difficile* cases remained on a par with the last few years, with almost half of the patients being 75 or older. With regard to laboratory methods, the share of nucleic acid detection rose to 60 per cent.
- The number of EHEC infections has been rising since 2013. Advances in laboratory diagnostics and epidemics are factors underlying the higher number of cases.
- Once again, frozen berries were the suspected source of an international epidemic of hepatitis A.
- The number of campylobacter infections has increased in 2014 and 2015, but the reason for this remains unknown. More information on the country of origin and sources of infections is necessary in order to target prevention measures.
- As in previous years, the number of norovirus infections was highest in January–May.
- Of rotavirus infections, almost 60% of cases occur in patients aged 5 and older, whereas the percentage of such cases before vaccinations was approximately 10%. More than one half of rotavirus cases in children under 5 years of age occurred in unvaccinated individuals.

## FOOD- AND WATER-BORNE OUTBREAKS

The National Institute for Health and Welfare supports municipal outbreak investigation working groups focusing on food- and water-borne outbreaks and, whenever necessary, coordinates the investigation of outbreakss e.g. if the outbreak in question is exceptionally severe or geographically widespread. In 2015, in cooperation with the University of Helsinki, the National Institute for Health and Welfare (THL) carried out a customer survey for environmental health care units in order to analyse the smoothness of cooperation between the local investigation working groups and THL. More than half of the working groups that responded had contacted THL on an annual basis. In addition to reporting epidemics, they most often contacted THL in order to assess whether further measures and investigations were necessary. The working groups' experiences of THL's epidemic analysis operations were mainly positive, but the respondents hoped that the register IT system for food poisoning epidemics (RYMY) and the statistical software for analysis of epidemics could be made more user-friendly. In 2015, 52 notifications of suspected cases were entered in the RYMY system (2014: 77). The National Institute for Health and Welfare (THL) contacted the municipal outbreak investigation working group with regard to 19 notifications. Several other gastrointestinal infection clusters were investigated as well.

In March–May, almost 100 tourists from different parts of Finland, who had visited Latvia, contracted an infection caused by the Salmonella *enteritidis* bacterium. The epidemic was detected in Kuopio when three individuals having participated in an ice hockey tournament in Riga were hospitalised due to severe gastrointestinal symptoms. The *S*. Enteritidis strain was more specifically typed in relation to 14 of the patients. The epidemic was caused by a strain

of MLVA type 3-10-6-4-1 and phage type FT 1. The questionnaire revealed a certain ice rink as the connecting factor and the majority of patients had had at least one meal at the ice rink during the weekend of the tournament. The National Institute for Health and Welfare (THL) informed the European Centre for Disease Prevention and Control (ECDC) and the World Health Organisation (WHO) about the epidemic, while the Finnish Food Safety Authority Evira informed the food safety authorities in Latvia. The international epidemic investigation coordinated by the ECDC has not yet been completed.

In April, 19 individuals from Kemiönsaari contracted diarrhoea and fever after visiting a cowshed. Some of them had consumed unprocessed milk on the farm. The *C. jejuni* strain found in 11 persons was typed using the PFGE method, while full genome sequencing was used in five cases. In addition, two *C. jejuni* strains from the milk filter in the milking robot, and two from the joint faeces of the cows, were typed. A campylobacter strain identical with the patients' strains was detected both in the milk filter and the faeces sample.

In July, 45 people contracted an infection caused by the *Salmonella* Newport bacterium in Helsinki, probably after consuming chia seed puddings. The puddings were prepared, unheated, at the shop which was selling them. Salmonella was not detected in the food samples analysed in connection with the epidemic.

In September, an estimated 700 people fell ill in Nurmijärvi in an epidemic suspected to have been caused by household water. A questionnaire conducted for schoolchildren revealed that the patients mainly suffered from short-term diarrhoea and stomach cramps. A total of 24 people consulted the local health centre, but no pathogens were detected in the two samples analysed from patients. The epidemic was detected when an *E. coli* bacterium was found in a water sample taken from the tank tower in Nurmijärvi as part of the supervision of the quality of drinking water supplied to households. Official analyses revealed coliform bacteria and *E. coli* bacteria in the samples taken from the Nurmijärvi tank tower and the water supply network. Even campylobacter was found in one of the samples from the water supply network. People were urged to boil all drinking water as it became clear that the household water supply had been contaminated, and the distribution of clean water began. It was suspected that the contamination was due to the tank tower becoming contaminated. A previous pipe breakage had resulted in loss of pressure in the network. As a consequence, the water reservoir in the tank tower became contaminated through a service hatch, ventilation or overflow pipe in the tower and, upon the next pipe breakage, all of the contaminated water from the tower entered the network. The general public was informed about the situation in bulletins distributed via public premises in the municipality and the online information system for the parents of schoolchildren and students, as well as via the municipality's website and an emergency warning. The contaminated network was cleaned by emptying and washing the tank tower, rinsing the networks and through protective chlorination (1–2 mg $Cl_2$/l) of the water within the network.

In November–December 2015, 12 cases of *Salmonella* Java were found in different parts of Finland. The strains found in the patients were divided into three types of PFGE, which were separated into two groups through full genome sequencing, and no common factor was established in interviews.

When epidemics arise, European countries can provide and gain information on epidemic investigations in other countries through the Epidemic Intelligence Information System EPIS, coordinated by the European Centre for Disease Prevention and Control (ECDC). In 2015, the National Institute for Health and Welfare participated in the prevention and examination of 57 international bacterial gastrointestinal epidemics, by providing up-to-date information on the situation in Finland.

## CLOSTRIDIUM DIFFICILE

In 2015, of the total of 5,821 cases of *Clostridium difficile* reported to the National Infectious Diseases Register, either 5,488 (94%) of cases involved a toxin-producing strain or PCR was the diagnostic method. The number of cases was similar to that of recent years. Women accounted for 57%, under 15-year-olds for 5% and 75-year-olds or older people for 48% of cases; 3% concerned under 2-year-olds. The four largest clinical microbiology laboratories accounted for more than 50% of the findings. Differences in incidence between hospital districts have

become slightly smaller, but remain significant (58─196/100,000).

The distinct change in laboratory methods that began in 2014 continued. Until 2013, most findings (80–90%) were cultured and less than 5% were nucleic acid detections, but in 2014 only 50% were cultures and the share of nucleic acid detections rose to 34%. In 2015, the use of nucleic acid detection methods almost doubled year-on-year, accounting for 60% of the findings, and the proportion of cultures decreased by 15 percentage points to 38% of the findings, while the share of antibody findings was under 10%.

In *C. difficile* diagnostics, the tests should should always be performed on diarrhoeal faecal samples that take on the shape of the container, the only exception being patients suffering from paralytic ileus or a toxic megacolon. Carriers showing no symptoms should not be screened.

The National Institute for Health and Welfare types strains related to suspected epidemics and severe individual cases. Of the strains typed in 2015, 65% produced not only A and B toxins but also binary toxins and had a deletion in the tcdC regulating gene. However, ribotype 027 was not involved. In addition, a sample of 200 consequent strains from the HUS region was typed in 2015. Ribotype 027 was not found in this sample either, and the majority of strains were ordinary toxin-producing strains of various ribotypes. Regardless of the absence of type 027, the share of strains producing binary toxins was 18% and 21% of the strains had a deletion in the tcdC regulating gene. These represented several different ribotypes, most commonly 016, 023, 078 and 126. The toxine gene profile of ribotype 016 is identical with ribotype 027 and in hypervirulence screenings, identified as ribotype 027 on a preliminary basis.

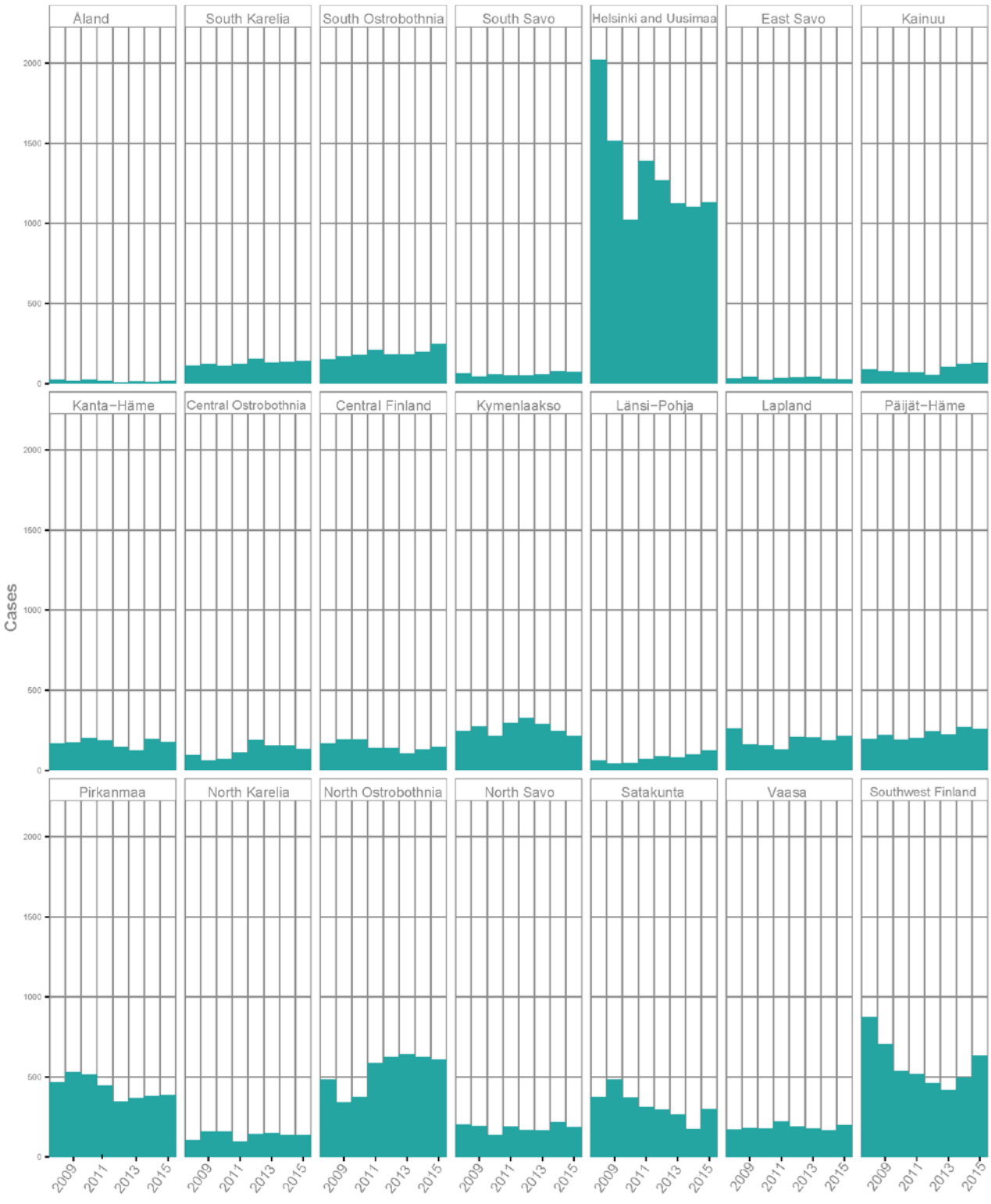


**Figure 6. Cases of Clostridium difficile by hospital district and by year, 2008–2015 (no. of cases).**

## ENTEROHAEMORRHAGIC ESCHERICHIA COLI (EHEC)

A total of 74 microbiologically confirmed cases caused by enterohaemorrhagic *Escherichia coli* (EHEC) were reported to the NIDR (1.4/100,000). The incidence was highest in the 0 to 4 age group (3/100,000) and 38% (28) of the cases were classified as being of domestic origin.

The number of EHEC infections has increased clearly since 2013 (2006–2012: 8–31, 2013: 98, 2014: 64). Changes in the laboratory diagnostics of EHEC, including the increasing number of PCR tests, explain the higher number of infections. Epidemics have also influenced the number of cases.

Since 2014, information on symptoms and exposure relating to EHEC infections of domestic origin has been collected using an electronic interview form completed by municipal officials responsible for infectious disease control. The interview data indicates that three patients were diagnosed with hemolytic uremic syndrome (HUS).

The bacterial culture of 64 EHEC cases sent to a laboratory, confirmed using the PCR method. The strain of 62 cases of EHEC was received for further analysis. Strains of serotype O157:H7 caused a total of 20 cases (32%), of which 9 were of domestic origin.

All O157 strains were sorbitol negative. Of the strains, 18 were positive for both stx1 and stx2 genes, while two had the stx2 gene only. The O157 strains were divided into 5 phage types, the PT 8 being most common in strains of both domestic and foreign origin. 95% of the strains were typed using PFGE genotyping. Only two strains had the same genotype (1.257), while the other strains analysed were individual types.

There were 42 cases of serogroup Non-O157. Of these, 50% were of domestic origin. Of serogroup O, the most common were O26 (9 strains), O55 (6), O103 (4) and O145 (4). All O145 strains, most of the O103- (3/4) and O55 strains (4/6) were of domestic origin, whereas more than one half (5/9) of the O26 strains were foreign. 86 % of the strains were typed using PFGE genotyping. The domestic O55 strains belonged to the same family cluster (genotypes O55d and O55h), while the other strains analysed were individual genotypes. Thirteen strains could not be typed using the traditional serotyping method based on agglutination, but their serogroup O was analysed through full genome sequencing.

Of the three HUS cases of domestic origin, two were caused by serotype O26:H11 and one by serotype O10:H2. All three strains were positive for the stx2 gene and eae gene and shared the same subtype of stx2 gene (stx2a).

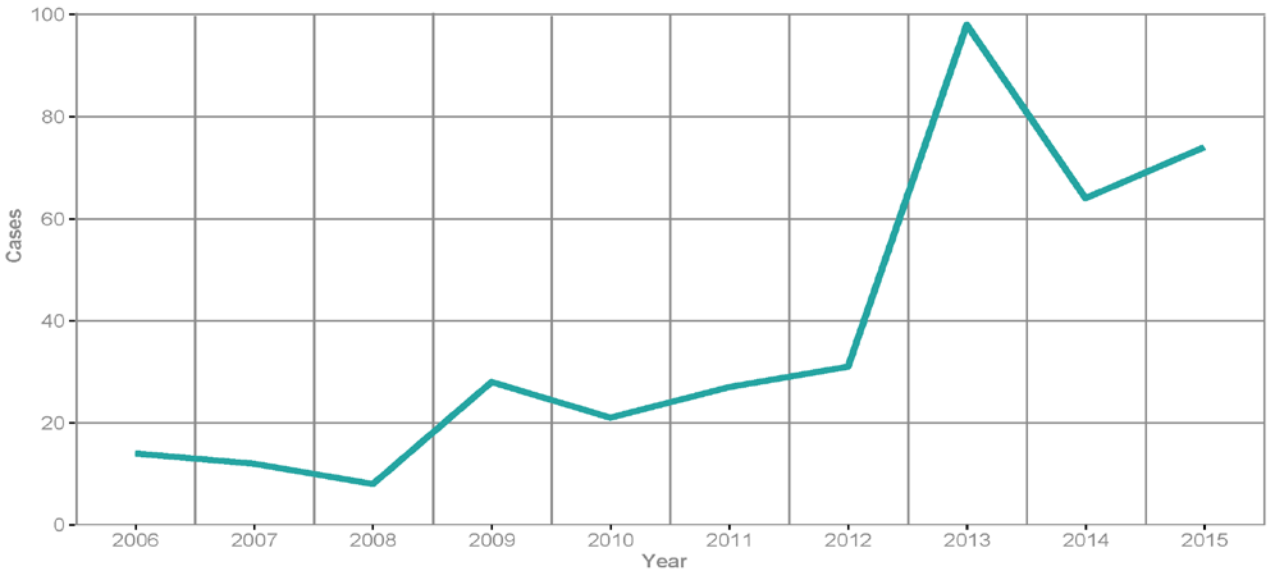


**Figure 7 EHEC cases by year, 2006–2015 (no. of cases).**

## CAMPYLOBACTER

Campylobacter is the most common bacterial cause of gastrointestinal infections in Finland. In 2015, 4,589 findings of campylobacter were reported (2014: 4,887). *Campylobacter jejuni* was by far the most common type of campylobacter (4,309), while 354 cases of *C. coli* were reported. The type was not specified in 154 cases.

The incidence in the entire population was 84/100,000. Men accounted for 55 percent of the cases, which were most common in the age group 25–29 (incidence 148/100,000). Incidence was highest in the hospital district of Helsinki and Uusimaa (121/100,000). Seasonal variation was typical for campylobacter as the incidence was highest in July–August.

In 55% of the cases, data was lacking on the country of acquisition. Of the infections, 14% (632) were of domestic origin. Foreign travel was a factor in many cases; the most common source being Spain (230), followed by Thailand (197) and Turkey (164).

The number of campylobacter infections has increased in 2014 and 2015 but the reason remains unknown. Since a large number of notifications lack data on the country of acquisition, it is difficult to assess the number of infections of domestic origin. More information on the country of origin and sources of campylobacter infections would be necessary if prevention measures are to be targeted.

The bacterial cultures of 21 cases of campylobacter were subtyped in THL; of these, 14 strains of *Campylobacter jejuni* were linked to the Kemiö epidemic originating in unprocessed milk. Five strains of *Campylobacter coli* were analysed due to suspected epidemics, but the tests revealed that this was not a question of an epidemic caused by an individual strain.

## LISTERIA

In 2015, a total of 46 systemic infections caused by the bacterium *Listeria monocytogenes* were diagnosed (2014: 65). Of these cases, one half were over the age of 75 and 57% (26) were women. The listeria cases were spread out across the country. For the time being, information on pregnancy is not being reported to the National Infectious Diseases Register. No cases of listeriosis were diagnosed in a newborn baby on the basis of laboratory referrals. Upon the introduction of electronic notification of infectious diseases by physicians, surveillance data for listeriosis will also be specified.

The *L. monocytogenes* strain isolated from the patient's blood and/or cerebrospinal fluid arrived for typing at THL. Of the strains, 37 (82%, 69% in 2014) were of serotype IIa, determined through PCR, 7 of group IVb and of group IIc. 42 of the strains were typed using PFGE and they were of 33 types of PFGE. According to PFGE, clusters of more than three cases did not occur. Full genome sequencing retroactively confirmed a five person cluster that occurred between June and October. In the PFGE analysis conducted on three out of five strains, the strains were of two PFGE types (Asc2-Apa4 and Asc5-Apa2).

Up-to-date PFGE profiles on *L. monocytogenes* strains were sent to the international database coordinated by the ECDC. In 2015, three small-scale international clusters were found that included the PFGE profiles of Finnish strains.

## SALMONELLA

In 2015, a total of 1,656 salmonella cases were reported (2014: 1,622), of which 55% had been detected in women. The annual incidence in the entire country was 30/100,000 population. The incidence was highest in the Hospital District of Central Ostrobothnia (40/100,000) and lowest in the Åland (7/100,000). The highest number of infections was reported in the 20 to 24 age group.

The *S.* Typhi bacterium, which causes typhoid fever, was identified in one person, who had travelled to Bangladesh. Six cases of *S.* Paratyphi, which causes paratyphoid fever, were found, four of Paratyphi A and two of Paratyphi B, five of which were related to travel abroad.

The bacterial strain of a total of 1,583 cases of salmonella was sent to the National Institute for Health and Welfare. The number of strains was slightly higher than in the previous year (1,428). Of them,

1,238 (78%) were of foreign and 311 (20%) of domestic origin. In 32 (2%) cases, the origin of the salmonella infection remained unclear.

Domestic salmonella infections were caused by 54 different serotypes. The three most common, including Typhimurium (79 cases), Enteritidis (59) and group B (30), caused 54% of infections. Most (80% cf. 2014: 70%) cases were still susceptible to all 12 antimicrobials tested, and the proportion of multiresistant strains decreased markedly from the previous years' level (2015: 12%; 2014: 20%; 2013: 21%).

Of the domestic strains of Typhimurium, only 6% were multiresistant (2014: 17%). Typhimurium strains were divided into 11 different phage types. The percentage (29%) of the traditional endemic PT 1 phage type was on a par with the previous year (2014: 32%). All PT strains were susceptible to antimicrobials.

The usual number of cases were caused by the domestic Enteritidis serotype (59, in 2014:). 49). Most strains were susceptible to all of the antimicrobials tested (80%). Enteritidis strains were divided into 15 different phage types, the most common, as in the previous year, being PT 8 (34%, 2014: 24%). The number of domestic group B cases (30) has stabilised after the increase of a few years ago. Most of the strains in group B were so-called monophasic *S.* Typhimurium strains (25 cases). All monophasic Typhimurium strains isolated from infections of domestic origin were multiresistant; most commonly to ampicillin, streptomycin, sulfonamide and tetracycline.

This resistance gives us reason to suspect that the monophasic Typhimurium strains are actually of foreign origin, e.g. secondary cases related to someone who returned from abroad or originating in an imported food product. Multiresistant monophasic Typhimurium strains are not known to occur in domestic farm animals. The most common monophasic phage type has varied in previous years (PT 120, PT 195, PT 193), but in 2015, PT 7A (7/25) was most common.

Of foreign strains, 19% were serotyped. Selection focussed on strains originating in the WHO/European countries (53 countries in Europe and close by). The most common serotypes were the same as in the previous year; Enteritidis, group B, Typhimurium and Stanley. The leading countries of acquisition for cases of foreign origin were Thailand (23%), Turkey (16%), Latvia (5%), Spain (5%) and Indonesia (3%). The number of strains from the WHO/European countries increased by almost one quarter year-on-year (577 cf. 402), while the number of strains originating outside the WHO/European countries was on a par with the previous year (661 cf. 691).

**Table 1. The most common serotypes of salmonella cases of domestic origin, 2007–2015 (excluding S. Typhi and S. Paratyphi) (no. of cases).**

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| **Domestically acquired infections (Source: National Institute for Health and Welfare, Bacterial Infections Unit)** | | | | | | | | | |
| Salmonella Typhimurium | 156 | 85 | 140 | 132 | 94 | 98 | 94 | 92 | 79 |
| Salmonella Enteritidis | 62 | 48 | 51 | 44 | 47 | 83 | 46 | 49 | 59 |
| Salmonella group B | 11 | 5 | 7 | 8 | 40 | 35 | 38 | 32 | 30 |
| Salmonella Newport | 28 | 71 | 9 | 8 | 6 | 7 | 11 | 9 | 27 |
| Salmonella Java | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 5 | 13 |
| Salmonella Infantis | 3 | 7 | 2 | 9 | 10 | 36 | 12 | 9 | 10 |
| Salmonella Saintpaul | 2 | 6 | 2 | 2 | 0 | 5 | 4 | 4 | 6 |
| Salmonella Stanley | 11 | 8 | 6 | 7 | 1 | 3 | 1 | 6 | 6 |
| Salmonella Oranienburg | 0 | 7 | 2 | 2 | 43 | 2 | 4 | 2 | 5 |
| Salmonella Panama | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 3 | 5 |
| Salmonella Agona | 40 | 15 | 2 | 2 | 11 | 33 | 12 | 8 | 4 |

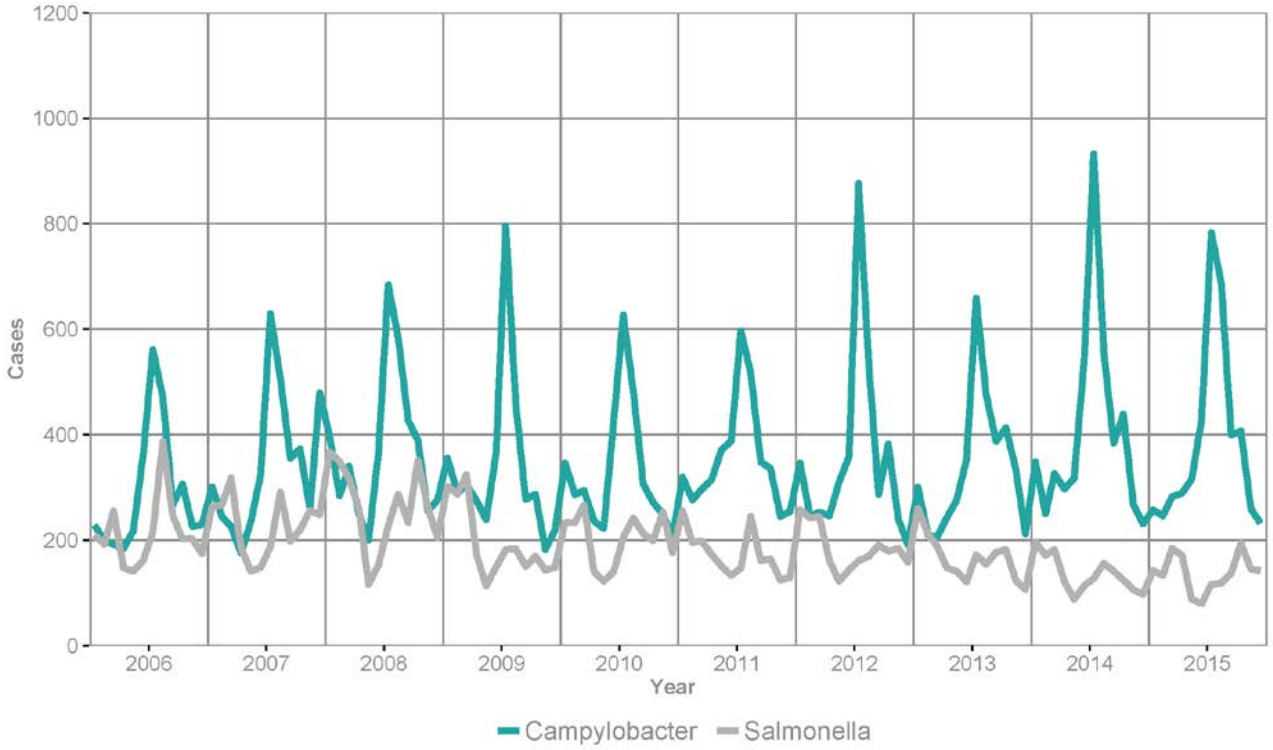


**Figure 8. Salmonella and campylobacter cases by month, 2006–2015 (no. of cases).**

## SHIGELLA

In 2015, the incidence of shigellosis was 1.6/100,000. The total number of cases reported was 92 (in 2014: 89). Of these, 52 were in women and the median age was 35 years (variation 1–73). The majority of cases (74) were detected in individuals aged 20–59, and 74% (68) were reported in the Helsinki and Uusimaa Hospital District. Eleven hospital districts had no diagnosed cases. The lack of findings in so many hospital districts gives reason to suspect problems in the primary diagnostics of shigella, which is known to be challenging.

The shigella strain of 85 persons was sent to the National Institute for Health and Welfare laboratory. Of the total, 67 infections (79%) were reported as having been acquired abroad, 16 in Finland and, in two cases, the country of acquisition was not reported. As in the previous year, the most common countries of origin were India (11 cases) and Thailand (6). A total of 52 strains (61%) were typed, including all infections of domestic origin and a sample of the foreign ones. The prevailing shigella species were *Shigella sonnei* (31 cases) and *Shigella flexneri* (17 cases). Antimicrobial susceptibility testing was performed on 53 strains, of which 43 (81%) were multiresistant (resistant to at least three of the 12 antimicrobialstested). Antimicrobial susceptibility testing was performed on nine of the domestic strains, of which 7 were multiresistant.

## YERSINIA

Yersinia findings are reported to the National Infectious Diseases Register under the Communicable Diseases Decree, which does not, however, require that Yersinia strains are sent to the National Institute for Health and Welfare THL. Since 2014, THL has only typed Yersinia strains related to special conditions such as epidemics or serious infections.

### *Yersinia enterocolitica*

In 2015, 560 cases of *Yersinia enterocolitica* were reported to the NIDR (2014: 499). The incidence rate in the entire country was 10/100,000 and was highest in the 25–29 age group (15/100,000). Regional variation was remarkable: the incidence was highest in the Helsinki and Uusimaa (17/100,000),

Central Ostrobothnia (13/100,000) and Kainuu (13/100,000) hospital districts. Only one case of *Y. enterocolitica* was diagnosed in the Åland Islands and East Savo hospital districts in 2015.

*Y. enterocolitica* is most commonly identified from a stool culture. In 2015, the number of cases confirmed by culture totalled 519, while 44 cases were identified by antibody findings in serum. Nine cases were identified by two different methods (PCR and culture or culture and antibody typing). In the Helsinki and Uusimaa hospital district, the typing result for *Y. enterocolitica* was given in 74% (198/267) of cases. Of the cases typed, 71% (140/198) were of biotype BT1A, 22% of bio/serotype BT4/O:3 and 7% BT2/O:9. BT 1A is a heterogenous group of strains that lack the pYV virulence plasmid typical of pathogenic yersinias. However, some BT 1A strains may have other properties affecting their pathogenic capabilities. The typing result of approximately one fifth (56/294) of cases was reported by other hospital districts. Of the cases typed, 48% were of biotype BT1A or strains whose virulence plasmid was not identified. Three strains of *Y. enterocolitica* isolated from blood were of serotype O:3.

### *Yersinia pseudotuberculosis*

The number of *Yersinia pseudotuberculosis* cases (16) in 2015 was considerably lower than in the previous year (74), when an epidemic related to unprocessed milk was diagnosed. In 2015, the incidence for the entire country was 0.3/100,000 inhabitants. Of the cases, 11 were confirmed by culture and 5 by antibodies.

## NOROVIRUS

In 2015, 2,164 cases of norovirus were reported to the National Infectious Diseases Register. Notifications were submitted by all hospital districts and, as in previous years, the majority in January–May (1,802, 83%). Cases occurred in all age groups, but more than one half of them in persons over 75 years old. The percentage of women was 57%.

Norovirus is one of the most common causes of food- and water-borne epidemics. In 2015, 15/52 suspected epidemics in which the suspected pathogen was norovirus were reported to RYMY, the national register IT system of THL and Evira.

Since late 2014, the most common type of norovirus typed by the THL is GII.e, found in almost all of the samples analysed in early 2015. The genotype GII.e has developed through mutations from the globally highly common genotype GII.4, detected in Finland for the first time in 2008. Other types of norovirus found in 2015 included GI.7, GI.2, GI.3, GI.5, GI.b and GII.17, confirmed as the pathogen in an epidemic diagnosed in Helsinki at the end of 2015. A norovirus of the genotype GII.17 caused epidemics in China in winter 2014–2015 and after that, several in Russia (22 epidemics/2015), France (4), Germany (1) and the Netherlands (1). In Finland, noroviruses GI.7 (2, Tampere) and GII.e (10, Kuopio), were also confirmed as having caused epidemics.

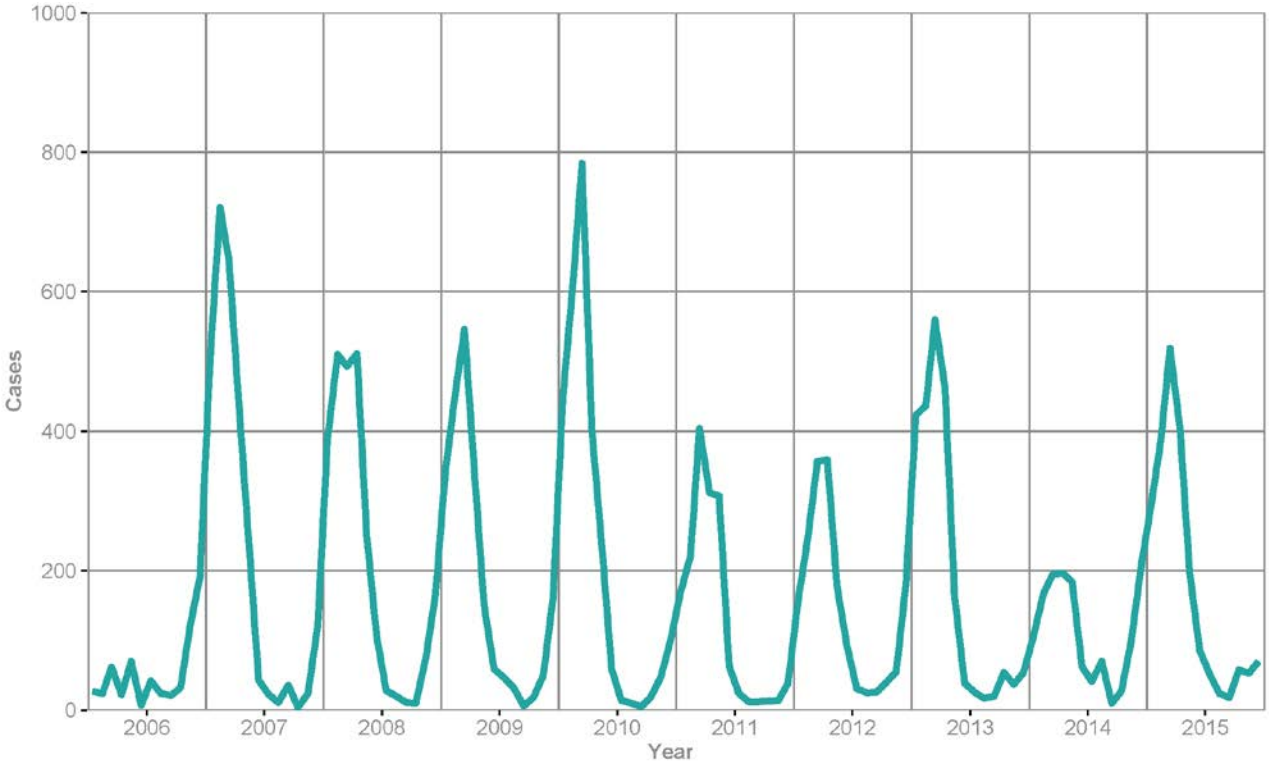


**Figure 9. Cases of norovirus infection by month, 2006–2015 (no. of cases).**

## ROTAVIRUS

In 2015, 251 cases of rotavirus were reported to the National Infectious Diseases Register. The number of cases has remained below 500 since the rotavirus vaccine was introduced to the national vaccination programme in 2009. Comprehensive rotavirus vaccinations for young children have clearly lowered the incidence of rotavirus infections in under 5-year-olds (2015: 36/100,000) in comparison with the average incidence (460/100,000) in this age group prior to the vaccination programme. A continuously increasing percentage of cases occur in patients aged 5 and older (2015: 57%), whereas the percentage of such cases before the vaccinations was approximately 10%. More than one half of rotavirus cases in children under 5 years of age occurred in unvaccinated individuals.

The National Institute for Health and Welfare maintains the microbial strain collection of rotaviruses in accordance with the Communicable Diseases Act and Decree and is monitoring whether the virus strains that have reduced due to vaccination are being replaced by other virus strains. Rotavirus positive findings sent by clinical laboratories to the National Institute for Health and Welfare are typed on the basis of molecular genetics by the University of Tampere Vaccine Research Center. In 2015, the most common type of rotavirus that caused outbreaks of cases was G2P[4]. The same genotype also prevailed in Austria and Belgium, where rotavirus vaccination coverage is as high as in Finland. After G2P[4], the next most common types of rotavirus in Finland were G1P[8], G9P[8], G3P[8] and G12P[8].

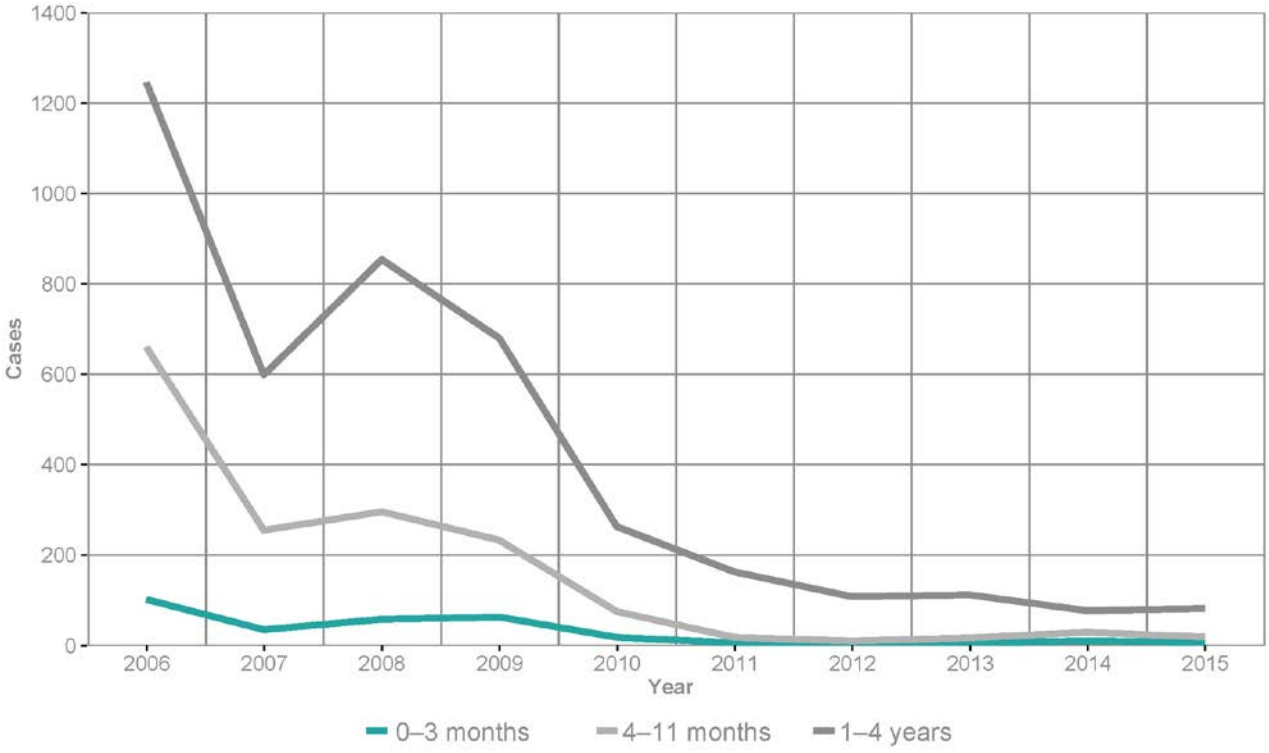


**Figure 10. Rotavirus cases by age group in children aged 0 to 4, 2006–2015 (no. of cases).**

# Hepatitis

- The number of hepatitis A infections of domestic origin was relatively high for the third year running, due to extensive international food-borne epidemics.
- Only six cases of acute hepatitis B infection were reported to the National Infectious Diseases Register. The decrease in the number of infections is mainly due to higher vaccination coverage.
- A significantly higher number of chronic hepatitis B infections was reported than in the previous year. The growth in the number of infections occurred among foreigners, who accounted for 90% of all cases.
- The majority of patients infected with hepatitis C in Finland were intravenous drug users. A very high percentage, around 75%, of intravenous drug users have been found to have hepatitis C antibodies

  .

## HEPATITIS A

In 2015, 45 cases of hepatitis A were reported (0.8/100,000) (2014: 27). The median age in these cases was 25 years (variation 1–66). Men accounted for 53% (24) of the cases, the highest number of them being reported in the Helsinki and Uusimaa Hospital District (28). Of these infections, 19 (42%) were contracted in Finland. The percentage of domestic infections was relatively high for the third consecutive year. The extensive international food-borne epidemics of recent years explain the situation.

## HEPATITIS B

In 2015, only six (0.1/100,000) acute cases of hepatitis B, i.e. ones that tested positive for IgM antibodies, were reported to the National Infectious Diseases Register, which is the lowest annual number so far. Four of the infected patients were of Finnish origin, two foreign. The mode of transmission was reported in one case only, being sexual contact. The country of acquisition was reported in four cases, in two as Finland and in the other two as a foreign country.

In the last ten years, the reported annual average number of acute hepatitis B infections is 20 whereas in the record year, 1998, almost 180 infections were reported. This decrease is mainly due to higher vaccination coverage. Vaccination of risk groups began in Finland in the 1990s. In addition, the vaccine has been popular, particularly among travellers. Moreover, needle and syringe exchange has probably prevented infections among users of intravenous drugs.

A significantly higher number of chronic hepatitis B infections, 391 (7.2/100,000), was reported than in the previous year. The growth in the number of infections occurred among foreigners, who accounted for 90% of all cases. Of these infections, 63% were reported in men and 37% in women The mode of transmission was reported in only 10% of cases, with perinatal infections and infections due to sexual contact being most common. 163 infections (2014: 42) were diagnosed in individuals who do not have a Finnish identity number. Growth in this group is partially explained by the fact that asylum seekers arriving in Finland have been actively screened for hepatitis B.

The number of cases of chronic hepatitis B has decreased since it peaked at over 600 in 1996. The reason is the sharp decline in the number of cases reported in Finns. No such decline has taken place among infections in foreigners.

## HEPATITIS C

In 2015, 1,165 (21/100,000) new cases of hepatitis C were reported to the National Infectious Diseases

Register, on a par with the previous year. The highest number of infections (33%) was reported in the Hospital District of Helsinki and Uusimaa, while the incidence rates were highest in the hospital districts of Länsi-Pohja (44/100,000), the Åland (38/100,000) and South Karelia (35/100,000) and the lowest in Central Ostrobothnia (9/100,000), South Ostrobothnia (11/100,000) and Central Finland (14/100,000).

Men accounted for 66% of the cases, which were most frequent in the age group 20–39, accounting for 67% of the cases. The incidence was highest (70/100,000) in the age group 20 to 24.

The majority of infections (81%) were diagnosed in individuals of Finnish origin. The country of acquisition was known in 58% of the cases. Of these, the majority (86%) were infections contracted in Finland.

Intravenous drug use was the most common method of infection (49%). Information on the mode of transmission was lacking in 40% of cases. Sexual contact was given as the mode of transmission in six per cent. Of these cases, one half was diagnosed in women, the other in men. Only one infection was reported as being acquired through sexual contact between men.

The majority of hepatitis C infections were reported without an identity number in 1995–1997. The high figures for hepatitis C in 1996–2000 (1,800 cases on average per year) may have been partially due to cases without identity numbers being registered several times, and the probable registration for those years of most cases initially diagnosed before surveillance began. Since 2003, the annual number of cases has varied between 1,100 and 1,200, the lowest figure being recorded in 2009 (1,036).

In all, almost 29,000 cases of hepatitis C have been reported to the National Infectious Diseases Register in 1995–2015. However, the total number of those infected and carriers is unknown because the prevalence rate of hepatitis C has not been studied at population level in Finland.

The majority of infected patients in Finland are intravenous drug users. A very high percentage, around 75%, of intravenous drug users have been found to have hepatitis C antibodies. Because of this, it is difficult to reduce the number of infections further in this group by means of needle and syringe exchange programmes alone. The number of carriers is growing because the number of new infections is clearly higher than the number of cases treated.

**Table 2. All cases of hepatitis C according to physicians' reports, by mode of transmission, 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Injecting drugs | 583 | 480 | 585 | 524 | 636 | 618 | 659 | 649 | 699 | 575 |
| Sex | 80 | 73 | 82 | 75 | 83 | 88 | 68 | 90 | 86 | 75 |
| Perinatal | 5 | 3 | 11 | 10 | 10 | 12 | 7 | 4 | 4 | 3 |
| Blood products | 8 | 24 | 20 | 5 | 14 | 8 | 7 | 11 | 13 | 14 |
| Other | 45 | 37 | 41 | 47 | 50 | 40 | 32 | 40 | 35 | 38 |
| Unknown | 480 | 575 | 432 | 417 | 378 | 401 | 406 | 379 | 396 | 471 |
| Total | 1,201 | 1,192 | 1,171 | 1,078 | 1,171 | 1,167 | 1,179 | 1,173 | 1,233 | 1,176 |

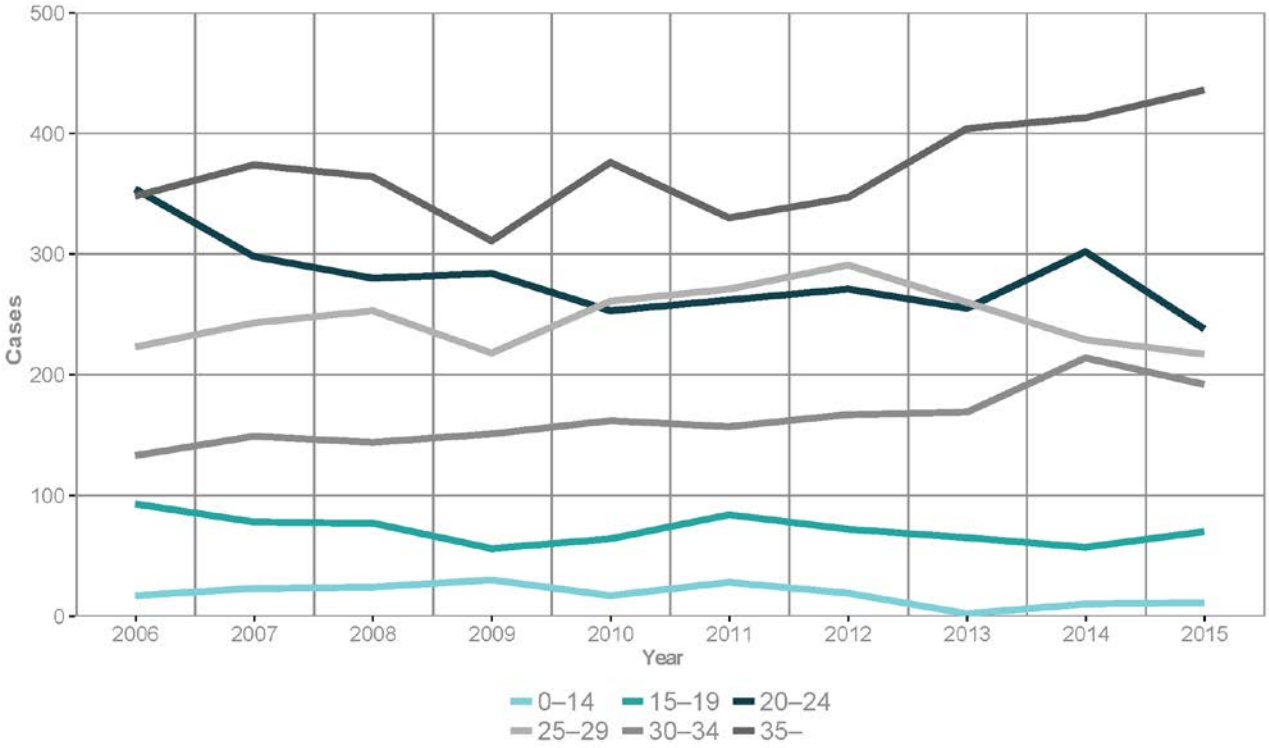


**Figure 11. Hepatitis C by age group, 2006–2015 (no. of cases).**

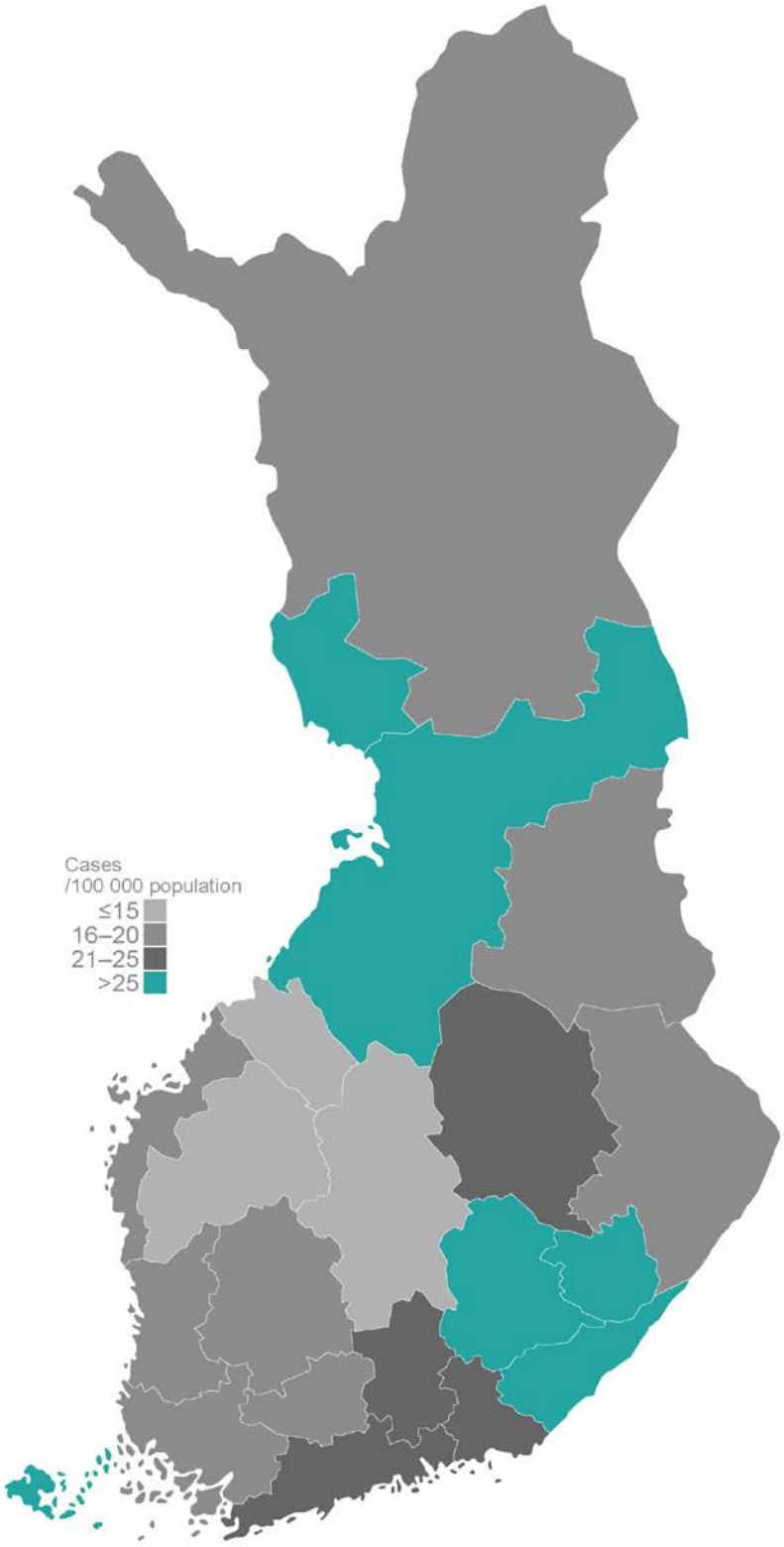


**Figure 12. Incidence of hepatitis C (cases/100,000 population) by hospital district, 2015.**

# Sexually transmitted diseases

- No significant changes have occurred in the number of chlamydia infections in the past five years.
- The number of gonorrhoea infections was almost equal to that of the previous year. More than half of the infections were acquired in Finland.
- The number of syphilis infections has increased in the last couple of years. The 249 cases diagnosed is the highest ever reported to the National Infectious Diseases Register.
- The number of HIV cases has not changed significantly in the past decade. In Finland, HIV is mainly a sexually transmitted disease, as the number of infections acquired through the use of intravenous drugs was below ten.
- No mother to child infections of Finnish origin have been diagnosed in screenings at maternity clinics.
- The number of new AIDS cases was 18, most being related to the late diagnosis of the infection.
- A significant percentage of syphilis, gonorrhoea and HIV infections contracted by Finnish men were the result of sexual contact between men.

## CHLAMYDIA (CHLAMYDIA TRACHOMATIS)

In 2015, a total of 13,571 cases of chlamydia were diagnosed. No significant changes have occurred in the number in the past five years. The highest number of cases (34%) was reported in the Hospital District of Helsinki and Uusimaa, but the incidence was highest (315/100,000) in the Hospital District of Lapland.

Typically for chlamydia, most cases were diagnosed in women and young adults: 58% of infections were reported in women and 81% in the age group 15–29. The incidence was highest (1,646/100,000) in the age group 20 to 24. One quarter of the infections in women was diagnosed in young individuals (age group 15–19); the corresponding share in men was lower at 11%. The majority (92%) of infections were diagnosed in individuals of Finnish origin.

## LGV (LYMPHOGRANULOMA VENEREUM)

Two cases of LGV, caused by *Chlamydia trachomatis*, were reported in 2015. Both cases involved a Finn, the mode of transmission being sexual contact between men abroad. Reporting of LVG cases began in 2011. All in all, 20 infections have been reported, all in men and 17 in Finns. The mode of transmission is known for 19 cases, being sexual contact between men in all of them.

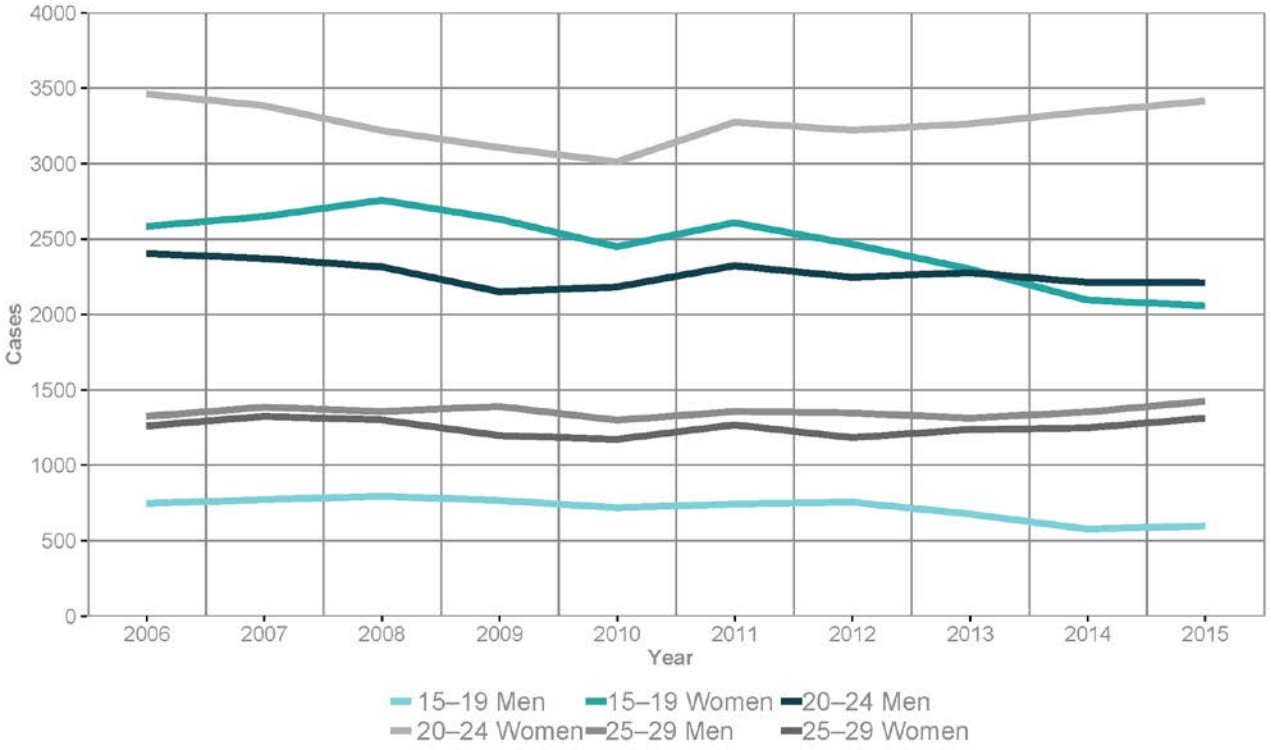


**Figure 13. Chlamydia cases in the young adult age groups, 2006–2015 (no. of cases).**

## GONORRHOEA (NEISSERIA GONORRHOEAE)

In 2015, 281 gonorrhoea infections (5.1/100,000) were diagnosed, an almost equal number to that of the previous year. The highest number of infections, accounting for 61% of all cases, was reported in the Helsinki and Uusimaa Hospital District, where the incidence was also highest, at 10.8/100,000.

The majority of infections (77%) was reported in men. The cases were most frequent in the age group 20–35, accounting for 66% of all cases. The incidence was highest (20.3/100,000) in the age group 25 to 29. The majority (75%) of infections were diagnosed in individuals of Finnish origin.

The country of acquisition was reported in 78% of cases, being Finland in 63%. As in previous years, the majority of infections contracted abroad originated in Thailand. Of these, all but one were diagnosed in Finns.

The gender of the sexual contact was reported in 79% of the cases. The percentage of sexual contact between men was significant,
as 64% of infections among men were contracted in this way. The majority (74%) were contracted in Finland.

Antimicrobial susceptibility was known in less than half of the gonorrhoea cases in 2014. Sufficient doses of ceftriaxon are still efficient in treating gonorrhoea, as by the end of 2014 no Gonococcus strains resistant to ceftriaxon had been reported in Finland.

**Table 3. Gonorrhoea infections acquired domestically and abroad, 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Finland | 107 | 78 | 88 | 113 | 124 | 136 | 165 | 154 | 144 | 139 |
| Thailand | 41 | 44 | 34 | 37 | 44 | 36 | 37 | 31 | 22 | 27 |
| Spain | 4 | 1 | 0 | 5 | 6 | 3 | 3 | 6 | 8 | 9 |
| Germany | 2 | 2 | 0 | 3 | 5 | 5 | 4 | 4 | 4 | 7 |
| Russia | 10 | 5 | 13 | 7 | 7 | 5 | 7 | 3 | 2 | 2 |
| Other country | 18 | 19 | 24 | 32 | 26 | 47 | 56 | 39 | 58 | 36 |
| Unknown | 50 | 43 | 39 | 39 | 41 | 52 | 43 | 27 | 48 | 61 |
| Total | 232 | 192 | 198 | 236 | 253 | 284 | 315 | 264 | 286 | 281 |

## SYPHILIS (TREPONEMA PALLIDUM)

The 249 syphilis infections (4.6/100,000) diagnosed in 2015 is the highest annual number so far reported to the National Infectious Diseases Register. The number of cases reported includes both active syphilis infections and old serological scars. Of the cases, almost one half (47%) were reported in the Helsinki and Uusimaa Hospital District, the incidence being 7.4/100,000.

The majority of infections (74%) were reported in men. Cases were most frequent in the age group 25–49, accounting for 67% of all cases. The incidence was highest (11.6/100,000) in the age group 35 to 39. Individuals of foreign origin accounted for 55% of the cases. 51 cases (2014: 29) were diagnosed in individuals who do not have a Finnish identity number. The growth in this group is partially explained by the fact that asylum seekers arriving in Finland have been actively screened for the disease.

The country of acquisition was reported in 63% of the cases, of which 62% were infections acquired abroad. However, infections acquired in the home country dominated by a share of 70% in individuals of Finnish origin.

The gender of the sexual contact was reported in one half of the cases. The percentage of sexual contact between men was significant,
as 74% of infections among men were contracted in this way. Of these, more than one half, 58%, were acquired in Finland.

**Table 4. Syphilis infections acquired domestically and abroad, 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Finland | 21 | 57 | 57 | 69 | 36 | 37 | 56 | 25 | 45 | 62 |
| Somalia | 3 | 4 | 7 | 10 | 5 | 10 | 5 | 3 | 1 | 12 |
| Russia | 17 | 16 | 25 | 18 | 26 | 19 | 29 | 22 | 23 | 11 |
| Estonia | 5 | 5 | 9 | 3 | 9 | 4 | 7 | 4 | 11 | 9 |
| Iraq | 0 | 0 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 8 |
| Spain | 1 | 2 | 3 | 1 | 5 | 2 | 3 | 5 | 2 | 8 |
| Thailand | 1 | 2 | 6 | 5 | 4 | 6 | 6 | 5 | 8 | 7 |
| Other country | 68 | 22 | 30 | 26 | 40 | 35 | 34 | 19 | 45 | 45 |
| Unknown | 20 | 78 | 73 | 65 | 78 | 62 | 65 | 69 | 67 | 87 |
| Total | 130 | 186 | 213 | 200 | 205 | 177 | 207 | 155 | 203 | 249 |

## HIV AND AIDS

In 2015, 173 new HIV infections were diagnosed (incidence 3.2/100,000). More than half, 53%, were reported in the Helsinki and Uusimaa Hospital District, where the incidence was also highest, at 5.8/100,000. Eighteen cases of AIDS were diagnosed. No deaths due to HIV infection were reported.

Of HIV infections, 75% were diagnosed in men, 25% in women. Individuals of foreign origin accounted for 56% of all cases. The majority of infections (90%) in Finns was reported in men, but the percentage of women, 36%, was higher among individuals of foreign origin. HIV is one of the infections screened in asylum seekers arriving in Finland. The number of HIV findings in persons who do not have a Finnish identity number has not increased in recent years, being 16 cases in 2015.

The majority of infections (68%) were acquired through sexual contact. Infections acquired through heterosexual contact accounted for 41% and sexual contact between men for 27% of these cases. Information on the mode of transmission was lacking in 25% of cases.

The reported number of infections contracted through heterosexual contact was 72, 61% being in men. Of these, individuals of foreign origin accounted for 57%. The majority (78%) of cases, among both Finns and foreigners, for which the country of infection was known were contracted abroad. As in previous years, Thailand was a prominent source of infection for Finns who had acquired the infection abroad.

The number of infections due to sexual encounters between men was 47. Of these, individuals of Finnish origin accounted for 62%. The majority (70%) of cases among Finns, for which the country of infection was known, were contracted in the home country.

Seven cases were diagnosed in which the infection was related to intravenous drug use, six of these in individuals of foreign origin. Infections of foreigners had all been contracted abroad. Since the epidemic at the turn of the millennium, efficient prevention methods have helped to keep the number of infections contracted in Finland at a low level.

Three mother to child infections were reported, all of foreign origin. A total of 44 infections were detected in maternity clinic screenings; in most of these, the HIV infection was known before pregnancy. The eight new cases diagnosed account for 19% of all HIV infections detected in women in 2015. Because of comprehensive screening at maternity clinics, and efficient HIV medication, no mother to child infections have been diagnosed in Finland since 2000.

One infection caused by blood products was reported in a foreign individual. Since HIV testing of donated blood began in Finland in 1985, no infectios through blood products cases have been reported of in Finland.

In 2015, 18 new cases of AIDS were reported, ten in individuals of Finnish and eight of foreign origin. In the majority of cases, AIDS was related to the late diagnosis of the infection. The reported number of HIV positive patients who died totalled 24, but no deaths due to the HIV infection were reported.

The CD4 value at the time the infection was diagnosed was reported in 83% of the cases. The percentage of late detection of infections (CD4 lower than 350) was 51%. The challenge therefore lies in detecting HIV infections earlier than at present.

By the end of 2015, the total number of HIV infections diagnosed in Finland was 3,513. The reported number of HIV positive patients who died was 442, but because of efficient HIV medication, the majority of deaths in the 2000s were due to reasons other than HIV.


**Figure 14. HIV cases by mode of transmission, 2006–2015 (no. of cases).**

# Antimicrobial resistance

- The number of MRSA infections was slightly lower than in the previous year, which was also revealed in blood culture findings.
- A previously rare strain of MRSA CC398, linked to production animals, was detected in 41 individuals in Finland.
- The number of VRE cases continued to decline, as only one blood culture finding was made and VRE findings in blood have been rare in general.
- The growth in the total number of ESBL *E. coli* findings seems to have come to a halt, as the number of findings has decreased in the age group 75 and older, but growth continued in younger age groups.
- The number of CPE findings doubled over 2014, with approximately one half of the CPE infections being acquired abroad.

## MRSA

In 2015, 1,274 new cases of MRSA (methicillin-resistant *Staphylococcus aureus*) were reported, slightly fewer than in the year before (2014: 1,342). The number of MRSA cases confirmed through blood culture findings was also lower than in the previous year (2015: 40; 2014: 46). Of the MRSA blood culture findings, 21 were in the Helsinki and Uusimaa Hospital District (1.3/100,000), while other hospital districts reported zero to three cases, totalling 19. Most (35/40) of the invasive cases occurred in men and in the age group 20–65 (23/40), only one occurred in children. The total number of cases was highest in the hospital districts of Helsinki and Uusimaa and Pirkanmaa, as were the incidence figures. As before, almost 40 per cent of the findings were related to patients aged 65 or over. The number of MRSA cases in children increased (2015:140; 2014: 108).

Patients arriving at hospital are screened for MRSA if they have been in a refugee camp or hospitalised abroad in the last 12 months. In 2015, 110 patients who did not have a Finnish identity number were diagnosed as MRSA carriers (2014: 20 findings). This group is highly likely to include not only tourists, but a significant number of asylum seekers as well.

The MRSA strain was typed in 1,348 individuals. There were 247 different spa types among the MRSA strains (2014: 205). The three most common spa types were the same as in previous years: t172 16% (2014: 19%), t008 8% (2014: 11%) and t067 6% (2014: 10%). The next most common spa types were t304, t127 and t002 (4% of each). Of these, the proportion of t304 (2014: 1%) and t127 (2014: 2%) has increased markedly in 2015. t172 was present in 17 hospital districts. As in previous years, the occurence of spa type t067 was most frequent in Pirkanmaa and the Hospital District of South Ostrobothnia, but the occurence of this strain continued its clear decline in 2015. In addition, local clusters were caused, among others, by t010, t032 and t020 in the Helsinki and Uusimaa Hospital District.

The two most common spa types among patients over 75 were t172 at 21% (2013: 19%) and t067 12% (2014: 17%). The most common spa types among children under the age of 16 were t127 at 9% (2014: 2%), t044 at 8% (2014: 8%) and t008 7% (2014: 14%).

An invasive MRSA strain was typed in 38 individuals. The most common spa types were t172 (2015: 10 and 2014: 6) and t008 (2015: 6 and 2014: 6). There were two cases of spa types t002, t026 and t10993, and the remaining cases (16/38) each represented different spa types.

In 2015, four MRSA strains with the *mecC* gene were isolated from clinical samples (2014: 6), of which one was isolated from blood. Of the strains, three were spa type t843 and one spa type t742.

In recent years, spa types of the MRSA CC398 complex, related to production animals, have become increasingly common in Europe. These strains have so far been rare in Finland. In 2007–2014, 48 strains of the CC398 complex were typed. In 2015, however, the number of strains clearly increased compared to the previous situation, as CC398 MRSA was typed in the case of samples from 41 individuals.

Spa type t034 is clearly the most common strain of the CC398 complex in Finland, and its numbers considerably increased last year (2015: 33, 2014: 14, 2013: 5, 2012: 2). So far, there have been three MRSA CC398 findings in blood in Finland (2015: t034 and t1250; 2013: t12593). Other spa types of the CC398 complex found in Finland include t011, t108, t571, t899, t2582 and t2741.

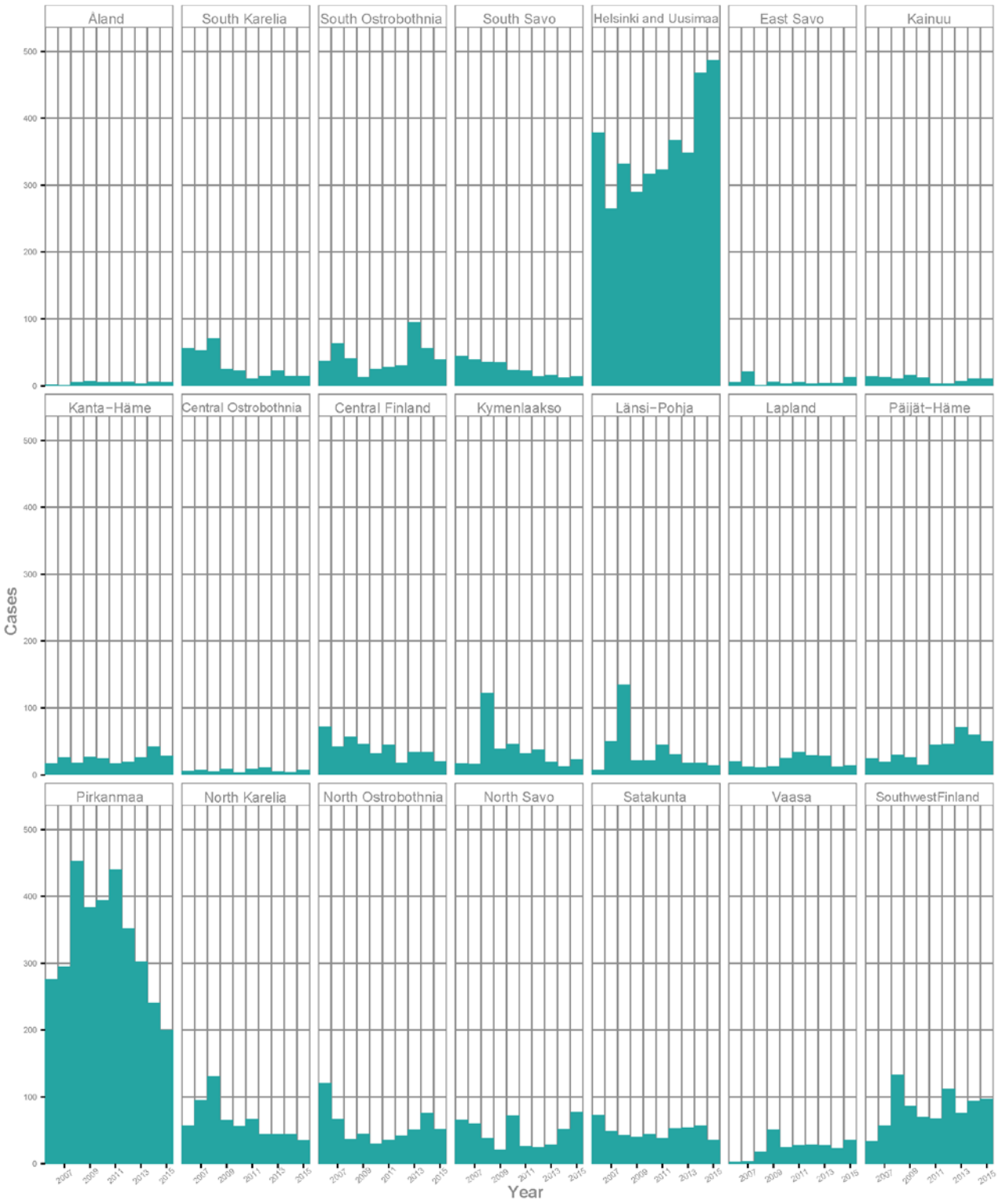


**Figure 15. MRSA cases by hospital district and by year 2006–2015 (no. of cases).**

**Table 5. MRSA findings and their percentage of S. aureus blood culture findings, 1995–2015 (no. of cases and %).**

| Year | MRSA findings | S.aureus blood culture findings | MRSA blood culture findings and S.aureus methicillin resistance (%) |
|---|---|---|---|
| 1995 | 89 | 627 | 2 (0.3) |
| 1996 | 110 | 667 | 0(0.0) |
| 1997 | 121 | 747 | 4 (0.5) |
| 1998 | 190 | 719 | 5 (0.7) |
| 1999 | 212 | 813 | 8 (1.0) |
| 2000 | 266 | 850 | 4 (0.5) |
| 2001 | 340 | 887 | 4 (0.5) |
| 2002 | 600 | 989 | 9 (0.9) |
| 2003 | 859 | 981 | 7 (0.7) |
| 2004 | 1,479 | 1,059 | 30 (2.8) |
| 2005 | 1,374 | 1,013 | 27 (2.7) |
| 2006 | 1,331 | 1,240 | 37 (3.0) |
| 2007 | 1,254 | 1,179 | 33 (2.8) |
| 2008 | 1,728 | 1,260 | 40 (3.2) |
| 2009 | 1,266 | 1,289 | 30 (2.3) |
| 2010 | 1,267 | 1,374 | 26 (1.9) |
| 2011 | 1,328 | 1,484 | 43 (2.9) |
| 2012 | 1,287 | 1,492 | 30 (2.0) |
| 2013 | 1,282 | 1,590 | 29 (1.8) |
| 2014 | 1,342 | 1,925 | 46 (2.4) |
| 2015 | 1,274 | 2,051 | 40 (2.0) |

## VRE

The number of reported cases of the vancomycin-resistant enterococcus (VRE) in 2015 decreased on the previous year (2015: 13, 2014: 32) The number of findings in hospital districts varied from zero to three. One of the findings was based on a blood sample. In fact, VRE has rarely been found in blood overall (2014: 0, 2013: 0, 2012: 1).

Of the total of 15 VRE findings sent to the microbial strain collection, 13 were of the species *E. faecium* and two *E. faecalis*. More *vanB* than *vanA* genes were found in these species (*vanB* 11; *vanA* 4). In addition, one strain of *E. raffinosus* with an acquired *vanA* gene was identified.

## ESBL – ESCHERICHIA COLI AND KLEBSIELLA PNEUMONIAE

Since the beginning of 2008, third-generation *Escherichia coli* and *Klebsiella pneumoniae* exhibiting reduced susceptibility or resistance to cephalosporin (I for intermediate and R for resistant, respectively) have been reported to the NIDR. An estimated 90 percent of these bacteria are extended-spectrum beeta-lactamase-producing, so-called ESBL strains that split penicillin andcephalosporins.

In 2015, the majority of findings were *E. coli* (4,175; in 2014: 4,190), and a small minority of *K. pneumoniae* strains (288; in 2014: 312). *E. coli* ESBL findings were made in all age groups, 72% in

women and almost one half in patients aged 65 or more. More than one half of findings (58%, 2,417/4,175) were based on urine cultures. The largest number of cases was found in the Hospital District of Helsinki and Uusimaa (1,332, 83/100,000), but the incidence was highest in the Åland Islands (138/100,000) and Kymenlaakso (111/100,000) hospital districts. The number of blood culture findings equalled the figures for 2014 (232 cf. 232) (the ESBL proportion in *E. coli* blood cultures: 232/4,532, 5.1% cf. 5.3% in 2014). Of these, 27% were in the Hospital District of Helsinki and Uusimaa. However, the incidence of blood culture findings was highest in the Hospital District of Vaasa.

More than 50% of ESBL findings involving *K. pneumoniae* were diagnosed in patients aged 65 or over but, at 63 per cent, the percentage of women was smaller than with *E. coli* ESBL findings. Almost one half of diagnoses (48%, 137/288) were based on urine. The largest number of cases were recorded in the hospital districts of Helsinki and Uusimaa (86) and Southwestern Finland (34), while the incidence was highest in the Länsi-Pohja and Kainuu hospital districts. Fifteen (2014: 20) of the findings were based on blood (the ESBL proportion in the *K. pneumoniae* blood cultures: 2015: 15/654, 2.3% cf. 2014: 3.2%).

As a whole, the increase in the number of *E. coli* findings exhibiting resistance to third-generation cephalosporin seems to have to come to a halt in Finland. The reason for this is reduced resistance in patients aged 75 or more. In younger age groups, the steady increase in resistance continued, which indicates continuing growth in the percentage of carriers within the healthy population. A decrease in *E. coli* ESBL strains isolated from blood is evident in older age groups, but as a whole, the incidence in blood and cerebrospinal fluid findings continued to grow, however not as intensely as before.

In 2015, an *E. coli* ESBL finding was made in 194 individuals with no Finnish identity number (2014: 69 findings), and *K. pneumoniae* ESBL finding in 24 (2014: 7 findings). This increase may partly be explained by the screening of bacteria resistant to antimicrobials in patients arriving in hospital, including not only tourists but probably a significant number of asylum seekers.

**Table 6. E. coli findings with reduced susceptibility to third-generation cephalosporins (possible ESBL, extended-spectrum β-lactamase) and ESBL percentage, 2008–2015 (no. of cases and %).**

| | ESBL findings | E. coli blood culture findings | ESBL E. coli blood culture findings and percentage of ESBL E. coli (%) |
|---|---|---|---|
| 2008 | 1,674 | 2,814 | 43 (1.5) |
| 2009 | 2,177 | 2,989 | 77 (2.6) |
| 2010 | 2,559 | 3,226 | 111 (3.4) |
| 2011 | 3,138 | 3,475 | 149 (4.3) |
| 2012 | 3,686 | 3,463 | 203 (5.9) |
| 2013 | 4,464 | 3,876 | 233 (6.0) |
| 2014 | 4,190 | 4,366 | 232 (5.3) |
| 2015 | 4,175 | 4,532 | 232 (5.1) |

**Table 7. K. pneumoniae findings with reduced susceptibility to third generation cephalosporins (possible ESBL, extended-spectrum β-lactamase) and ESBL percentage, 2008–2015, (no. of cases and %).**

| | ESBL findings | K. pneumoniae blood culture findings | ESBL K. pneumoniae blood culture findings and percentage ESBL K. pneumoniae (%) |
|---|---|---|---|
| 2008 | 116 | 418 | 3 (0.7) |
| 2009 | 156 | 480 | 6 (1.3) |
| 2010 | 190 | 508 | 16 (3.1) |
| 2011 | 242 | 453 | 10 (2.2) |
| 2012 | 242 | 583 | 10 (1.7) |
| 2013 | 238 | 570 | 12 (2.1) |
| 2014 | 312 | 634 | 20 (3.2) |
| 2015 | 288 | 654 | 15 (2.3) |

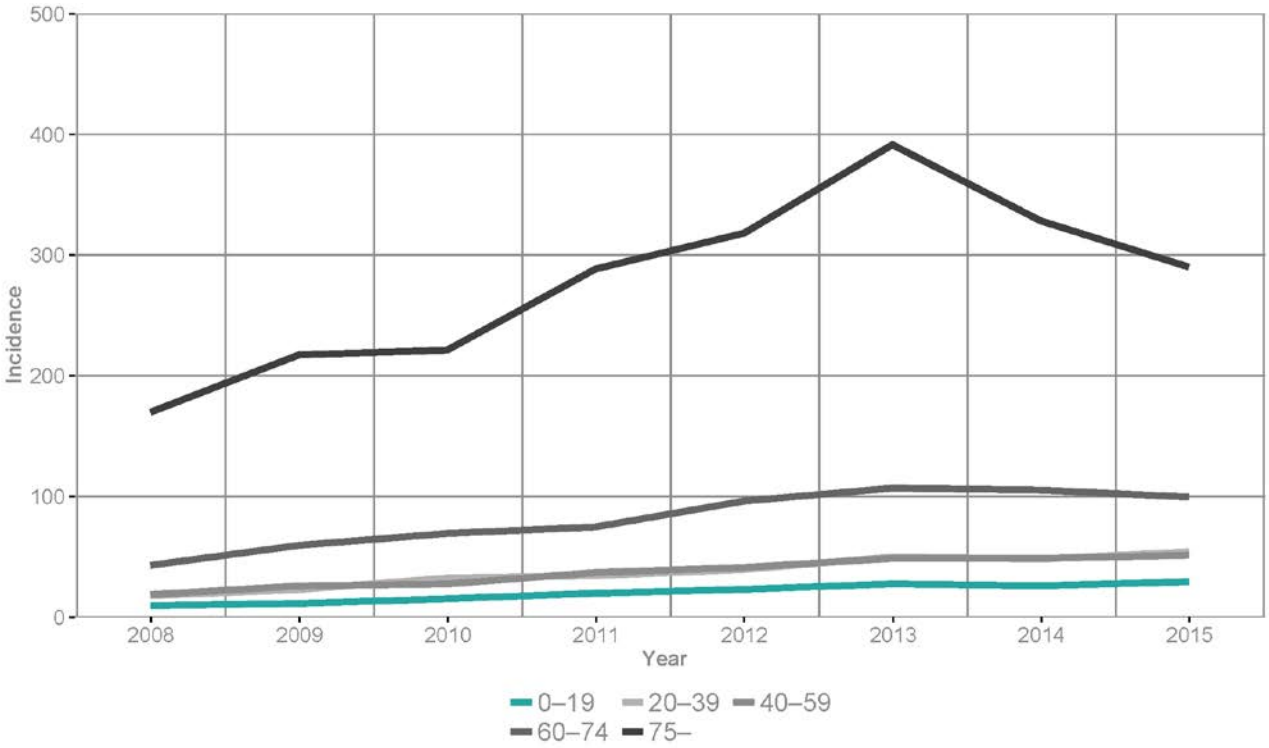


**Figure 16. Incidence of E. coli findings (cases/100,000 population) with reduced susceptibility and resistance to third-generation cephalosporins (possible ESBL, extended-spectrum β-lactamase) by age group 2008–2015.**

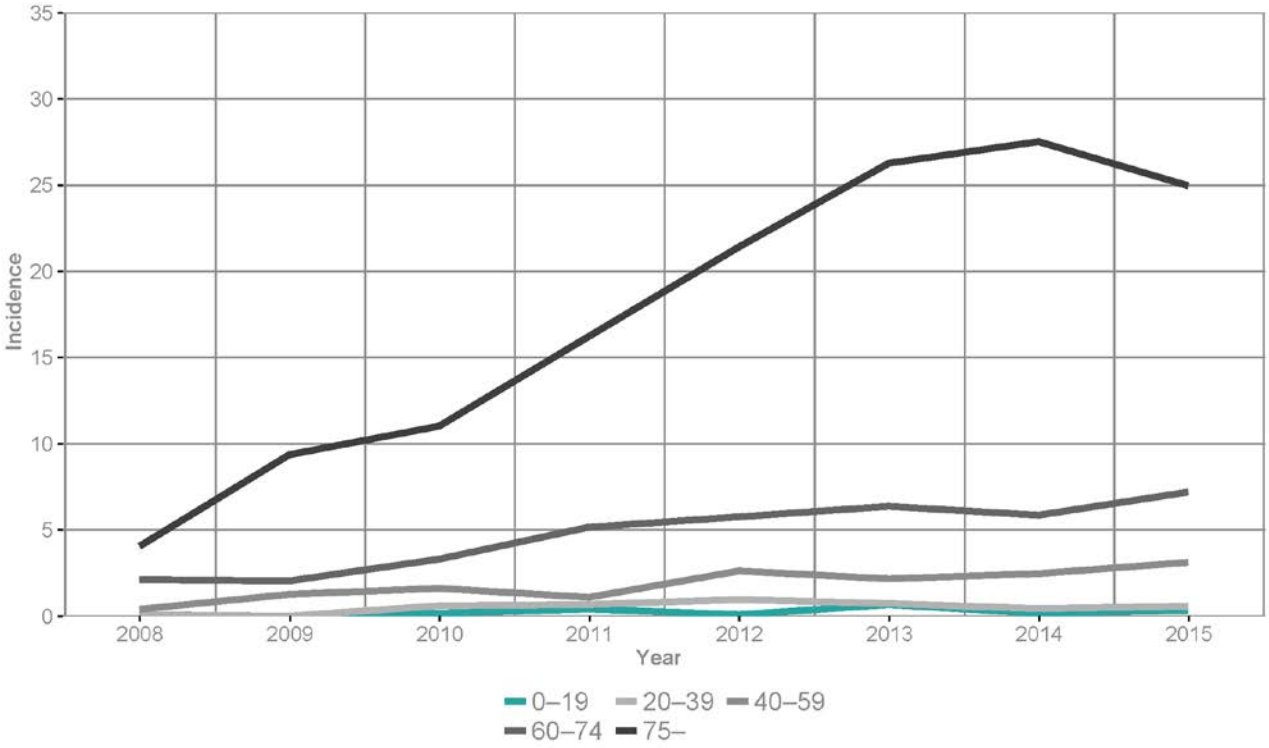


**Figure 17. Incidence of E. coli findings (blood and cerebrospinal fluid findings /100,000 population) with reduced susceptibility and resistance to third-generation cephalosporins (possible ESBL, extended-spectrum β-lactamase) by age group 2008–2015.**

## CPE (CARBAPENEMASE-PRODUCING ENTEROBACTERIA)

In 2015, 55 findings were reported to the National Infectious Diseases Register showing enterobacteria with reduced susceptibility (intermediate, I) or resistance (resistent, R) to carbapenemase, i.e. the bacterial strain was possibly CPE. Of the findings reported, 25 were *E. coli*, 20 *Klebsiella pneumoniae* and 10 *Enterobacter cloacae*. Of the reported findings, in 39 cases the bacterial strain was sent for confirmation tests to the laboratory of the National Institute for Health and Welfare. Of the strains sent, 24 were actual CPE strains. In addition, 139 possible CPE strains were sent to the National Institute for Health and Welfare, of which five proved to be carbapenemase-producing. The total number of actual CPE findings was 29, which meant that the number of findings doubled over 2014. Most findings involved *K. pneumoniae* strains (14), but *E. coli* was common as well (10). In addition to these, other individual species of enterobacteria with the carbapenemase gene were isolated in 2015, including three strains of *Citrobacter freundii* (KPC, VIM, GES). In 2015, the most common carbapenemases were KPC and NDM, and the OXA-48 group was the third most common (10, 10 and 6).

More than half of the CPE infections were probably acquired abroad, particularly in Asia and Southern Europe. The cluster caused by a KPC-positive *K. pneumoniae* (ST512), detected in 2015 but probably initiated back in 2013, explains the high percentage of domestic ones. The majority of CPE strains were isolated in colonisation samples. The median age of patients was 64.

The number of CPE cases is still very low in Finland, but increasing slightly. *K. pneumoniae* is the most common finding (about 60% of all findings). Species with reduced susceptibility to carbapenemase, reported to the National Infectious Diseases Register, account for over 90% of all CPE findings in Finland. Until now, KPC positive *K. pneumoniae* strains have caused all clusters diagnosed in care facilities in Finland. The role of other species in terms of hospital hygiene remains unclear.

**Table 8. Carbapenemase-producing enterobacteria (CPE), 2009–2015, (no. of cases).**

| | CPE findings | |
|---|---|---|
| | New bacterial strains | New patients |
| 2009 | 5 | 5 |
| 2010 | 8 | 8 |
| 2011 | 12 | 11 |
| 2012 | 9 | 8 |
| 2013 | 21 | 20 |
| 2014 | 17 | 14 |
| 2015 | 29 | 29 |

**Table 9. Carbapenemase-producing enterobacteria (CPE) and possible foreign contact 2015, (no. of cases).**

| Country | Patients | Genes |
|---|---|---|
| No contact/not known | 14 | 6 KPC*, 4 OXA-48 groups, 2 NDM, 1 VIM, 1 GES |
| India | 4 | NDM |
| Greece | 3 | 2 KPC, 1 VIM |
| Egypt | 1 | NDM |
| Spain | 1 | KPC |
| Italy | 1 | KPC |
| Canary Islands | 1 | OXA-48 |
| Croatia | 1 | NDM |
| Cuba | 1 | NDM |
| Thailand | 1 | IMP |
| Tunisia | 1 | OXA-48 |

*Epidemic

**Table 10. The most common types of gene combinations for Carbapenemase-producing enterobacteria (CPE) in Finland 2009–2015, (no. of cases).**

| | KPC | NDM | OXA-48 | VIM |
|---|---|---|---|---|
| K. pneumoniae | 30 | 10 | 10 | 5 |
| E. coli | 2 | 19 | 9 | 0 |

# Tuberculosis

- There were around ten more cases of tuberculosis than in 2014.
- All children who contracted tuberculosis were of foreign origin.
- The percentage of foreigners among patients contracting tuberculosis was 39%, up by one fifth year-on-year.
- The number of tuberculosis drug-resistant *Mycobacterium tuberculosis* strains has increased slightly in recent years.

## TUBERCULOSIS (MYCOBACTERIUM TUBERCULOSIS)

### Incidence of tuberculosis 2015

The number of tuberculosis cases was 271 (5.0/100,000), 11 (4%) cases more than in 2014 (260; 4.8/100,000). Of these, 195 (72%) were cases of pulmonary tuberculosis, 62 (32%) of which produced a positive sputum stain test. There were 215 cases of tuberculosis confirmed by culture (62%), two more than in 2014 (213).

The increase in the overall number of tuberculosis cases in Finland in 2007 and 2008 compared to 2006 can be explained by the introduction in 2007 of the broader EU definition of tuberculosis cases. The annual numbers of cases confirmed by culture are comparable throughout the monitoring period. The number of these cases remained stable from 2007 to 2011 except in 2009, when an exceptionally large number of cases in foreigners was recorded; in 2012–2015, however, the figure became stable again.

The distribution of cases by age group was as follows: under 15, 12 (4%); 15 to 29, 65 (24%); 30 to 44, 43 (16%); 45 to 59, 24 (9%); 60 to 74, 50 (19%); and over 75, 77 (29%). Population reduction among the age groups in whose youth the incidence of tuberculosis in Finland was high, and the increasing number of young immigrants, has led to a notable decrease in the average age of tuberculosis patients between 2000 and 2015, from 64 to 52 years. In 2015, all 12 children who were diagnosed with tuberculosis were of foreign origin.

The patient was reported to be foreign in 105 cases (39%), i.e. born abroad and assumed to have other than Finnish citizenship unless the data indicate otherwise. This was 19 (22%) more than in the previous year. The distribution of these cases by age group was as follows: under 15, 7(7%); 15 to 29, 51 (49%); 30 to 44, 32 (30%); 45 to 59, 11 (10%); and over 60, 4 (4%) (Figure 18). Among these, there were 77 cases (73%) of pulmonary tuberculosis and 28 cases (27%) of other forms of tuberculosis. Information on the patient's country of birth or citizenship was missing in 17 cases (6%). 32 cases (12%) were diagnosed in individuals who do not have a Finnish identity number. Some of them are likely to be asylum seekers. The corresponding figure was six the year before.

In four (1%) of the tuberculosis cases reported in 2015, the patient also had an HIV infection. In one of these cases, the HIV infection was reported as a new case in 2015, while the HIV infection of the three other cases had been registered before. Three persons were of foreign and one of Finnish origin.

### Tuberculosis strain susceptibility to medication in 2015

Although susceptibility to medication is still fairly good, the number of *Mycobacterium tuberculosis* strains resistant to tuberculosis medication has grown. Of all cultured strains, 89% had full susceptibility and, in 24 cases, resistance to one or several drugs was diagnosed. Of the eight MDR cases diagnosed during the year, one case was an extended-drug resistant (XDR) tuberculosis. One of the MDR cases was in a patient born in Finland, others were

from Somalia, Estonia, Russia and Afghanistan. Four MDR cases were diagnosed in asylum seekers.

## Tuberculosis genotyping findings 2015

*Mycobacterium tuberculosis* strains were analysed using the internationally standardised spoligotyping and MIRU-VNTR methods. The most common spoligotypes were SIT53 and the so-called Beijing type SIT1, 25 of each were detected (12%). Clusters sharing the same spoligo and MIRU-VNTR type totalled 40, including a total of 68 strains, 34% of the total number of strains typed. The most common cluster, which even caused exposure in a school in Oulu, was of genotype SIT1 (7 cases). The second most common cluster was the so-called Nordic cluster, with five new cases in various parts of the country.

## Tuberculosis outcome surveillance in 2010-2014

Table 12 shows the distribution of treatment outcomes between 2010 and 2014. The domain consists of cases of pulmonary tuberculosis confirmed by culture, genetic replication or staining. Cases where the pathogen is an MDR strain are reported separately and are not included in Table 12. An outcome evaluation is performed 12 months after the case is registered.

A significant number (63) of outcome evaluation reports for 2014 were missing when the annual report was written, but the treatment outcome was good in 76% of cases in 2013. This falls clearly short of the international target set by the WHO at 85%, but is on a par with the average for most EU Member States. Mortality (before beginning treatment or during treatment) was 17% in 2013.

## Other mycobacteria

A total of 670 non-tuberculotic, environmental mycobacteria were identified (incidence 12.3/100,000). The most common of these found in patient samples were *Mycobacterium avium* (*n*=192), *Mycobacterium gordonae* (*n*=156) and *Mycobacterium intracellulare* (*n*=84), ten of which were diagnosed in children under the age of 5.

**Table 11. Incidence of tuberculosis (cases/100,000 population) and percentage of culture-confirmed cases in Finland, 1995–2015 (no. of cases and %).**

| | Pulmonary tuberculosis | | | Other tuberculosis | | All cases | | | | Foreigners | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cases | Incidence | Cases with positive sputum smear | Incidence | Cases | Incidence | Cases | Incidence | Culture-confirmed | Culture-conf.% | Cases | % |
| 1995 | 436 | 8.6 | 243 | 4.8 | 223 | 4.4 | 659 | 12.9 | 472 | 71.6 | 30 | 4.6 |
| 1996 | 451 | 8.8 | 243 | 4.7 | 206 | 4.0 | 657 | 12.8 | 511 | 77.8 | 36 | 5.5 |
| 1997 | 359 | 7.1 | 188 | 3.7 | 214 | 4.3 | 573 | 11.4 | 440 | 76.8 | 43 | 7.5 |
| 1998 | 399 | 7.8 | 207 | 4.0 | 213 | 4.1 | 612 | 11.9 | 493 | 80.6 | 50 | 8.2 |
| 1999 | 399 | 7.7 | 183 | 3.5 | 193 | 3.7 | 592 | 11.5 | 506 | 85.5 | 41 | 6.9 |
| 2000 | 372 | 7.2 | 225 | 4.4 | 170 | 3.3 | 542 | 10.5 | 455 | 83.9 | 42 | 7.7 |
| 2001 | 316 | 6.1 | 155 | 3.0 | 182 | 3.5 | 498 | 9.6 | 416 | 83.5 | 58 | 11.6 |
| 2002 | 297 | 5.7 | 136 | 2.6 | 178 | 3.4 | 475 | 9.1 | 394 | 82.9 | 44 | 9.3 |
| 2003 | 293 | 5.6 | 147 | 2.8 | 122 | 2.3 | 415 | 8.0 | 351 | 84.6 | 39 | 9.4 |
| 2004 | 233 | 4.5 | 127 | 2.4 | 102 | 2.0 | 335 | 6.4 | 291 | 86.9 | 33 | 9.9 |
| 2005 | 269 | 5.1 | 137 | 2.6 | 103 | 2.0 | 372 | 7.1 | 324 | 87.1 | 41 | 11.0 |
| 2006 | 206 | 3.9 | 99 | 1.9 | 90 | 1.7 | 296 | 5.6 | 271 | 91.6 | 47 | 15.9 |
| 2007 | 229 | 4.4 | 93 | 1.8 | 118 | 2.2 | 347 | 6.6 | 251 | 72.3 | 67 | 19.3 |
| 2008 | 213 | 4.0 | 105 | 2.0 | 127 | 2.4 | 340 | 6.4 | 246 | 72.4 | 46 | 13.5 |
| 2009 | 289 | 5.5 | 94 | 1.8 | 124 | 2.4 | 413 | 7.9 | 303 | 73.4 | 116 | 28.1 |
| 2010 | 225 | 4.2 | 85 | 1.6 | 92 | 1.7 | 317 | 5.9 | 250 | 78.9 | 101 | 31.9 |
| 2011 | 232 | 4.3 | 84 | 1.6 | 92 | 1.7 | 324 | 6.0 | 252 | 77.8 | 80 | 24.7 |
| 2012 | 194 | 3.6 | 83 | 1.5 | 82 | 1.5 | 276 | 5.1 | 223 | 80.8 | 81 | 29.3 |
| 2013 | 213 | 3.9 | 92 | 1.7 | 58 | 1.1 | 271 | 5.0 | 204 | 75.3 | 87 | 32.1 |
| 2014 | 196 | 3.6 | 80 | 1.5 | 64 | 1.2 | 260 | 4.8 | 213 | 81.9 | 86 | 33.1 |
| 2015 | 195 | 3.6 | 62 | 1.1 | 76 | 1.4 | 271 | 5.0 | 215 | 61.6 | 105 | 38.7 |

**Table 12. Results of outcome evaluation for treatment of microbiologically confirmed pulmonary tuberculosis, 2009–2014 (no. of cases and %).**

| | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|
| **Favourable** | 149 (80%) | 131 (70%) | 122 (74%) | 142 (76%) | 73 (44%) |
| Cured | 94 | 74 | 63 | 82 | 44 |
| Treatment completed | 55 | 57 | 59 | 60 | 29 |
| **Non-favourable** | 22 (12%) | 38 (20%) | 27 (16%) | 33 (18%) | 23 (14%) |
| Deceased | 18 | 37 | 27 | 32 | 22 |
| Interrupted treatment | 4 | 0 | 0 | 0 | 1 |
| Treatment failure | 0 | 1 | 0 | 1 | 0 |
| **Missing** | 15 (8%) | 17 (9%) | 16 (10%) | 12 (6%) | 72 (42%) |
| Transfer | 2 | 7 | 7 | 3 | 4 |
| Treatment continues at 12 months | 8 | 8 | 8 | 4 | 5 |
| Unknown | 5 | 2 | 1 | 5 | 63 |
| **Total** | 186 | 186 | 165 | 187 | 168 |

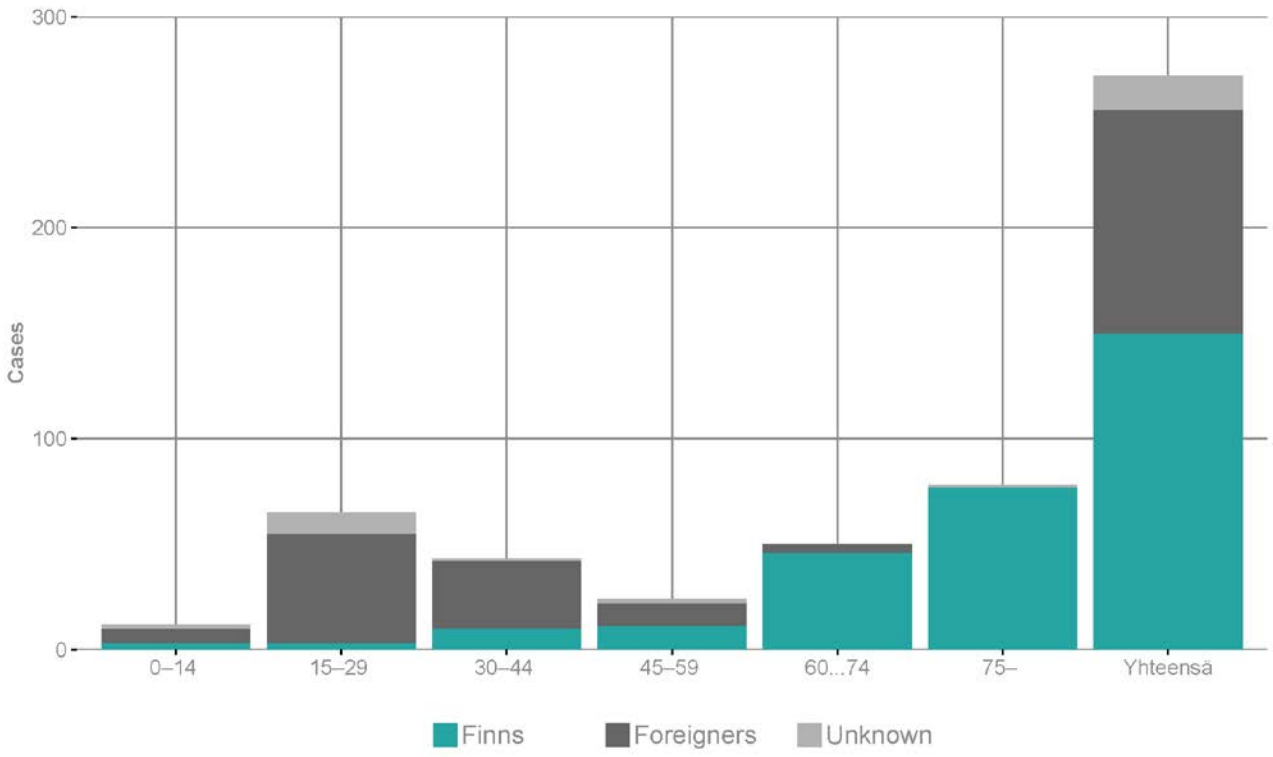


**Figure 18. Tuberculosis cases by age group and origin in 2015, (no. of cases).**

# Other infections

- Around a hundred more cases of severe pneumococcal infection were diagnosed than in 2014.
- The incidence of serotypes not included in the pneumococcal conjugate vaccine increased in the adult age groups. In patients aged 65 or older, 80% of cases were caused by serotypes not included in the vaccine. The ageing of the population and possible changes in disease diagnostics and the prevalence of the risk factors of pneumococcal disease may contribute to the increase.
- The number of meningococcus infections was on a par with the previous year. Serogroups C and Y caused infections, particularly in young people in the age group 15–19 and serogroup W in adults.
- Four adults in the same workplace, born before the MMR vaccinations were introduced, contracted rubella.
- A record number of borrelia cases was reported and the incidence is highest in the autumn, from August to October.
- The number of tick-borne encephalitis (TBE) cases, almost 70, was also record-high. In mainland Finland, most TBE infections were contracted in known risk areas. Porkkala, Oulu, Ilomantsi, Muurame, the Rauma archipelago and Vierumäki emerged as new potential areas of infection.
- Fewer cases of Puumala virus were reported than in 2014. More than half of the patients were men, the majority being of working age.
- Only 15 cases of Pogosta disease were reported, the lowest figure ever in the history of the National Infectious Diseases Register.
- A total of 32 people were exposed to rabies abroad, mainly in Thailand. More than half of the cases of exposure abroad were related to a dog bite.
- All cases of malaria originated in Africa. Approximately one half of the patients were immigrants coming from a malarious area, who had travelled in their former home region. None of the patients who fell ill had used the appropriate prophylaxis.
- Almost 15,000 bacterial findings were detected in cultured blood samples from adults. These findings have constantly increased, particularly in patients aged 65 or over. *Escherichia coli* was the most common finding in both the working age population and in patients aged 65 and older. Other common findings include *Staphylococcus aureus*, of which a significant percentage is known to be treatment-related infections.
- The number of early-onset GBS cases in newborns was record-breakingly low at 13 (0.2 cases per 1,000 live births). This is probably due to improved preventive practices.

## INVASIVE PNEUMOCOCCAL DISEASE (STREPTOCOCCUS PNEUMONIAE)

The reported number of invasive, severe cases of pneumococcal disease, in which the pathogen was identified in a blood or cerebrospinal fluid culture,was 815 (14.9/100,000). This is approximately a hundred more than in 2014 (703; 12.9/100,000). In addition, the number of cases reported on the basis of nucleic acid detection totalled only 9. No serotype data is available for these cases and they are not included in the statistics below.

The incidence of pneumococcal disease continued to decrease in under 18-year-olds, but increased in the older age groups (table 13). Of the patients, 2.8% were under the age of 5 and 52.4% over 65. As before, the incidence was higher among men than among women (16.3 cf. 13.5/100,000). Variation in incidence between hospital districts more than quadrupled (6.9–29.9/100,000), which may be due to differences in how actively blood cultures are taken.

The serotype of 800 (98%) cases of pneumococcal disease confirmed by culture was identified. These cases were divided into 39 serotypes or serogroups. As in the previous year, serotype 3, caused almost one fifth (145; 17.8%) of all cases. The next most common serotypes were 19A (139; 17.1%) and 22F (79; 9.7%) (figure 19). These three were common pathogens, particularly in the elderly, as was serotype 19A in children under the age of 5, in whom it caused 57% (13/23) of all infections. Together, they caused 45% of all cases (in 2014, 41%). Compared with the previous year, serotypes 19A increased most (2015: 139 cf. 2014: 95), 6C (40 cf. 13) and 3 (145 cf. 121).

The 10-valent pneumococcal conjugate vaccine (PCV10) has been included in the national basic vaccination programme for children since September 2010. Severe pneumococcal diseases caused by serotypes in the PCV10 vaccine (1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F, 23F) have almost been eliminated in young children and continued to decrease in 2015, particularly in the 5 to 17, 18 to 64 and 65 and over age groups, compared to the years (2006–2009) which were prior to the introduction of the vaccine. This is an indirect consequence of the vaccination programme for children. In children under 2 years of age, one case caused by PCV10 serotypes was diagnosed in an unvaccinated child. Moreover, three other infections caused by PCV10 serotypes were diagnosed in older children (table 14).

The incidence of serotypes not included in the PCV10 vaccine increased in the adult age groups, particularly cases caused by serotypes 19A, 6C and 3. In patients aged 65 or older, 80% of cases were caused by serotypes not included in the PCV10 vaccine. The ageing of the population and possible changes in disease diagnostics and the prevalence of the risk factors of pneumococcal disease may contribute to an increase in disease incidence. For more detailed statistics by age and serotype, please see the National Institute for Health and Welfare website.

Antimicrobial sensitivity was determined for 840 strains of invasive pneumococcus (Table 15). Strains with reduced susceptibility to penicillin (MIC > 0.06 mg/L) accounted for 15% of the strains, and three strains completely resistant to penicillin (MIC > 2 mg/L) were found. The percentage of macrolide-resistant strains continued to decrease; 14% of invasive pneumococcal strains were resistant to erythromycin. Multiresistant strains (PEN IR–ERY R–TET R) accounted for 5% of the strains. One strain of pneumococcus resistant to levofloxacin (MIC>2 mg/L) was found in 2015. No strains resistant to ceftriaxone (MIC > 2 mg/L) were found. More multiresistant strains than before were found.

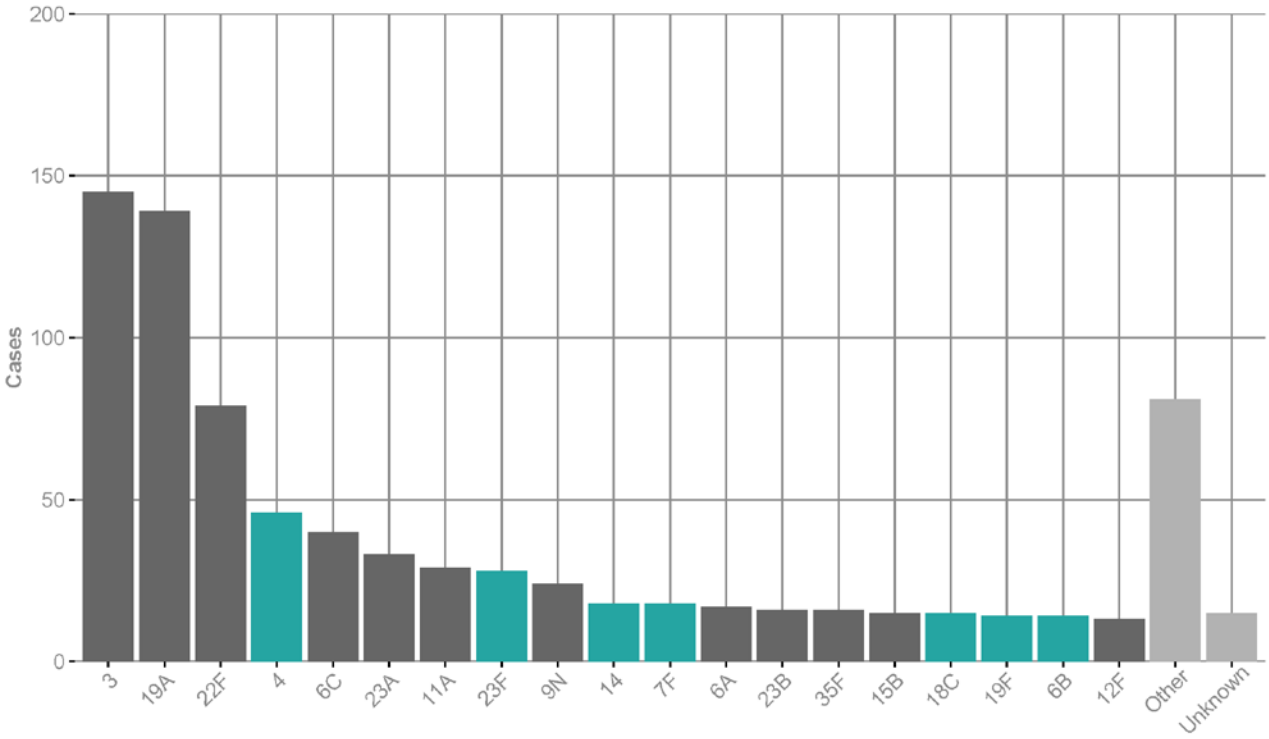


**Figure 19. Serotypes of Streptococcus pneumoniae findings in blood and cerebrospinal fluid 2015 (no. of cases).**
**The column ”Other” includes serotypes that caused fewer than 10 cases and the column “Unknown” includes cases whose strains the National Institute for Health and Welfare did not receive.**
**PCV10 serotypes, turquoise columns.**

**Table 13. Pneumococci isolated in blood and cerebrospinal fluid 2006–2015, no. of cases and incidence (cases/100,000 population).**

| | 0–1 | | 2–4 | | 5–17 | | 18–64 | | 65– | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| year | Cases | I | Cases | I | Cases | I | Cases | I | Cases | I | Cases | I |
| 2006 | 82 | 71.3 | 31 | 18.4 | 19 | 2.3 | 345 | 10.5 | 271 | 32.3 | 748 | 14.2 |
| 2007 | 78 | 67.4 | 45 | 26.5 | 20 | 2.5 | 351 | 10.7 | 291 | 33.9 | 785 | 14.9 |
| 2008 | 65 | 55.1 | 32 | 18.4 | 23 | 2.9 | 479 | 14.4 | 328 | 37.5 | 927 | 17.5 |
| 2009 | 62 | 52.2 | 31 | 17.6 | 32 | 4.2 | 434 | 13.0 | 295 | 33.1 | 854 | 16.3 |
| 2010 | 61 | 50.6 | 41 | 23.8 | 17 | 2.2 | 410 | 12.2 | 304 | 33.4 | 833 | 15.6 |
| 2011 | 45 | 37.0 | 27 | 15.7 | 21 | 2.7 | 386 | 11.6 | 297 | 31.7 | 776 | 14.5 |
| 2012 | 15 | 12.3 | 17 | 9.4 | 15 | 1.9 | 361 | 10.8 | 342 | 34.9 | 750 | 13.9 |
| 2013 | 19 | 15.8 | 14 | 7.6 | 14 | 1.8 | 358 | 10.8 | 319 | 31.3 | 724 | 13.3 |
| 2014 | 13 | 11.0 | 14 | 7.6 | 18 | 2.3 | 303 | 9.1 | 355 | 33.6 | 703 | 12.9 |
| 2015 | 11 | 9.5 | 12 | 6.5 | 14 | 1.8 | 351 | 10.6 | 427 | 39.2 | 815 | 14.9 |

**Table 14. Pneumococci isolated in blood and cerebrospinal fluid by age and serotypes 2008–2015, no. of cases and incidence (cases/100,000 population).**

| | PCV10 vaccine serotypes | | | | | | | | | | | | Non-vaccine serotypes | | | | | | | | | | | | Unknown | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0–1 | | 2–4 | | 5–17 | | 18–64 | | 65– | | Total | | 0–1 | | 2–4 | | 5–17 | | 18–64 | | 65– | | Total | | All age groups | |
| year | Cases | I | Cases | I | Cases | I | Cases | I | Cases | I | Cases | I | Cases | I | Cases | I | Cases | I | Cases | I | Cases | I | Cases | I | Cases | I |
| 2006 | 67 | 58.3 | 26 | 15.42 | 15 | 1.8 | 227 | 6.9 | 161 | 19.2 | 496 | 9.4 | 14 | 12.2 | 5 | 3.0 | 3 | 0.4 | 105 | 3.2 | 101 | 12.5 | 228 | 4.3 | 24 | 0.5 |
| 2007 | 63 | 54.5 | 38 | 22.41 | 12 | 1.5 | 226 | 6.9 | 176 | 20.5 | 515 | 9.8 | 15 | 13.0 | 5 | 3.0 | 6 | 0.8 | 116 | 3.5 | 111 | 12.9 | 253 | 4.8 | 17 | 0.3 |
| 2008 | 49 | 41.5 | 26 | 14.98 | 18 | 2.2 | 288 | 8.7 | 198 | 22.6 | 579 | 10.9 | 14 | 11.9 | 6 | 3.5 | 4 | 0.5 | 174 | 5.2 | 119 | 13.6 | 317 | 6.0 | 31 | 0.6 |
| 2009 | 47 | 39.6 | 26 | 14.75 | 23 | 2.9 | 277 | 8.3 | 165 | 18.5 | 538 | 10.3 | 12 | 10.1 | 4 | 2.3 | 8 | 1.0 | 141 | 4.2 | 118 | 13.2 | 283 | 5.4 | 33 | 0.6 |
| 2010 | 51 | 42.3 | 35 | 19.7 | 10 | 1.3 | 244 | 7.3 | 168 | 18.5 | 508 | 9.5 | 8 | 6.6 | 5 | 2.8 | 5 | 0.6 | 148 | 4.4 | 122 | 13.4 | 288 | 5.4 | 37 | 0.7 |
| 2011 | 34 | 28.0 | 16 | 8.93 | 15 | 1.9 | 217 | 6.5 | 149 | 15.9 | 431 | 8.0 | 11 | 9.5 | 11 | 6.1 | 6 | 0.8 | 166 | 5.0 | 145 | 15.5 | 339 | 6.3 | 6 | 0.1 |
| 2012 | 8 | 6.6 | 16 | 8.82 | 7 | 0.9 | 190 | 5.7 | 150 | 15.3 | 371 | 6.9 | 7 | 5.8 | 1 | 0.6 | 8 | 1.3 | 169 | 5.6 | 187 | 19.9 | 372 | 6.9 | 7 | 0.1 |
| 2013 | 6 | 5.0 | 3 | 1.63 | 9 | 1.2 | 163 | 4.9 | 113 | 11.1 | 294 | 5.4 | 13 | 10.8 | 11 | 6.0 | 5 | 0.7 | 191 | 5.7 | 206 | 20.2 | 426 | 7.9 | 4 | 0.1 |
| 2014 | 2 | 1.7 | 3 | 1.63 | 8 | 1.3 | 99 | 3.0 | 93 | 8.8 | 205 | 3.8 | 11 | 9.3 | 11 | 6.0 | 10 | 1.3 | 202 | 6.9 | 258 | 24.4 | 492 | 9.0 | 6 | 0.1 |
| 2015 | 1 | 0.9 | 3 | 1.64 | 4 | 0.5 | 80 | 2.4 | 75 | 6.9 | 163 | 3.0 | 10 | 8.6 | 9 | 4.9 | 10 | 1.3 | 265 | 8.3 | 343 | 31.5 | 637 | 11.7 | 15 | 0.3 |

**Table 15. Antimicrobial resistance of pneumococcus findings in blood and cerebrospinal fluid, 1998–2015 (no. of cases and %).**

| Year | Cases reported to the National Infectious Diseases Register | Analysed strains | Erythromycin (R) % | Penicillin (I+R) (%) | Multidrug resistance (%) |
|---|---|---|---|---|---|
| 1998 | 561 | 84 | 3.6 | 0 | 0 |
| 1999 | 568 | 471 | 5.9 | 7.2 | 0 |
| 2000 | 601 | 439 | 8 | 3.7 | 1.4 |
| 2001 | 658 | 360 | 18.8 | 7.5 | 5 |
| 2002 | 599 | 594 | 16.3 | 8 | 3.7 |
| 2003 | 721 | 739 | 21.9 | 12.7 | 5.7 |
| 2004 | 748 | 748 | 20.5 | 9.6 | 3.7 |
| 2005 | 735 | 731 | 20.5 | 9.6 | 4.4 |
| 2006 | 748 | 760 | 27.9 | 16.4 | 5.4 |
| 2007 | 785 | 794 | 23.2 | 14.4 | 3.5 |
| 2008 | 927 | 930 | 24.5 | 17.7 | 3.4 |
| 2009 | 854 | 848 | 28.4 | 19.9 | 4.7 |
| 2010 | 833 | 819 | 28.6 | 23.4 | 1.7 |
| 2011 | 776 | 780 | 26.8 | 21.9 | 2.8 |
| 2012 | 750 | 754 | 22.2 | 27.7 | 5 |
| 2013 | 724 | 668 | 16.8 | 18.7 | 4 |
| 2014 | 703 | 716 | 14.5 | 14.8 | 2.4 |
| 2015 | 815 | 840 | 13.9 | 14.5 | 5 |

I - reduced susceptibility; R - resistant; Multidrug resistance - strains simultaneously resistant to penicillin (I+R), erythromycin (R) and tetracyclin (R)

## HAEMOPHILUS (HAEMOPHILUS INFLUENZAE)

The total of 52 (0.95/100,000) infections caused by the *Haemophilus influenzae* bacterium, diagnosed in blood or cerebrospinal fluid, is on a par with the average of the two previous years. More than a third (19/52, 37%) were diagnosed in patients aged 75 years or over.

All cases were diagnosed through culture findings. As in earlier years, the majority of these (40/52, 77%) were caused by unencapsulated strains of *Haemophilus influenzae*. Only one infection caused by serotype b was found, in an adult individual in whose childhood the Hib vaccine was not yet part of the national vaccination programme. Serotype f caused an infection in nine people, one of whom was a six-month old baby and the other eight were adults. Serotype e caused two infections, both in elderly adults.

Children born in 1985 or later have been given the Hib vaccine at their child care clinics. The vaccination programme has succeeded in effectively reducing the number of serious infections caused by bacteria of serotype b, and the circulation of bacteria within the population, but cases may still occur in children with incomplete vaccination coverage.

**Table 16. Cases of Haemophilus influenzae by serotype in 2006–2015, (no. of cases).**

| | Unencapsulated | a | b | e | f | Unknown | All cases |
|---|---|---|---|---|---|---|---|
| 2006 | 26 | 0 | 2 | 0 | 2 | 3 | 33 |
| 2007 | 44 | 0 | 6 | 1 | 1 | 2 | 54 |
| 2008 | 33 | 0 | 3 | 0 | 8 | 1 | 45 |
| 2009 | 30 | 0 | 6 | 2 | 7 | 2 | 47 |
| 2010 | 30 | 0 | 5 | 2 | 3 | 1 | 41 |
| 2011 | 57 | 0 | 4 | 2 | 2 | 1 | 66 |
| 2012 | 73 | 0 | 4 | 0 | 4 | 0 | 81 |
| 2013 | 40 | 1 | 1 | 1 | 5 | 0 | 48 |
| 2014 | 48 | 0 | 5 | 0 | 6 | 0 | 59 |
| 2015 | 40 | 0 | 1 | 2 | 9 | 0 | 52 |

## MENINGOCOCCUS (NEISSERIA MENINGITIDIS)

In 2015, the number of meningococcus infections detected in blood or cerebrospinal fluid totalled 22 (0.40/100,000), which is around the same as in 2014. Of these cases, one half were diagnosed in men, six (27%) in the age group 0–4, seven (32%) in the 15–19 age group and nine (41%) in the 44–77 age group. Twenty cases were diagnosed through a bacterial culture finding and two through nucleic acid detection. All bacterial strains were serogrouped and analysed through full genome sequencing, a method introduced in 2015. Eight (40%) were of serogroup B, five (25%) of serogroup C, four (20%) of serogroup W and three (15%) of serogroup Y; but the serogroup for two cases diagnosed through nucleic acid detection remained unknown. The majority of infections caused by serogroup B were diagnosed in young children (3 cases) and patients aged 40 and over (4 cases). Serogroup C and Y caused infections in young people aged 15–19 and serogroup W in adults in particular. Closer comparison of the bacterial genome revealed two small clusters, one caused by a bacterium of serogroup W and the other, serogroup C.

Except for the strains that caused clusters, most of the bacterial strains were different, being based on the genotyping results of several different types. There were four types of serogroup C strains, of which one (C:P1.7,16-29:F3-3:ST-32 (cc32)) caused a cluster of two cases in Western Finland. Of the two types of serogroup W strains, one (W:P1.18-1,3: F4-1: ST-2878 (cc22)) caused one case and the other, (W:P1.5,2: F1-1: ST-11 (cc11)) three cases in Southern Finland. In two of these cases the genome of the bacteria was almost identical. Since the bacterial clone W:P1.5,2: F1-1: ST-11 (cc11) has become more common in recent years, particularly in England and Wales, in autumn 2015 England replaced the meningococcus C conjugate vaccine in the national vaccination programme for young adults with the ACWY conjugate vaccine that provides broader protection. Regardless of the cases diagnosed, meningococcus W is still very rare in Finland.

In sporadic cases of meningococcus infection, all persons in close contact with the patient – except for health care personnel – should be given prophylactic medication and a vaccination, if infection with the strain in question can be prevented by vaccination. Finland has vaccines against the meningococcus serotype groups A, C, W and Y. The Defence Forces are administering a quadrivalent polysaccharide vaccination to all recruits, but infections belonging to serogroup B are still being found among them, since the vaccine affords no protection from it. No meningococcus infections were diagnosed in the Defence Forces in 2015. Conjugated meningococcus vaccines are mainly used in connection with epidemics and travel. New vaccines against group B meningococcus strains have entered the market, but are not yet used in Finland.

**Table 17. Meningococcal infections by serogroup, 2006–2015 (no. of cases).**

| | A | B | C | W | Y | Unknown | Total |
|---|---|---|---|---|---|---|---|
| 2006 | 0 | 38 | 5 | 0 | 1 | 1 | 45 |
| 2007 | 0 | 29 | 8 | 0 | 5 | 0 | 42 |
| 2008 | 0 | 18 | 8 | 0 | 1 | 1 | 28 |
| 2009 | 0 | 24 | 3 | 0 | 5 | 1 | 33 |
| 2010 | 0 | 14 | 4 | 1 | 13 | 2 | 34 |
| 2011 | 0 | 19 | 6 | 1 | 7 | 1 | 34 |
| 2012 | 0 | 17 | 3 | 1 | 8 | 4 | 33 |
| 2013 | 0 | 10 | 2 | 0 | 8 | 0 | 20 |
| 2014 | 0 | 7 | 5 | 1 | 5 | 3 | 21 |
| 2015 | 0 | 8 | 5 | 4 | 3 | 2 | 22 |

## MMR DISEASES (MEASLES, MUMPS, RUBELLA)

In 2015, the occurrence of diseases prevented by the MMR vaccine was similar to previous years in Finland, with the exception of rubella, of which a few more cases were diagnosed than in recent years.

Two cases of measles were diagnosed. One of the patients was a foreign-born adult, who had arrived in Finland a while before the outbreak of the disease. The other patient was an unvaccinated 1-year-old child born in Finland. In this case, the source of infection remained unknown.

Mumps was diagnosed in two individuals, both infected abroad. One of the patients was a male of foreign origin, whose vaccination coverage is unknown and the other was a male born in Finland. His series of MMR vaccinations had not been completed.

Five laboratory findings of rubella were reported (2014: 0, 2013: 3). Congenital rubella syndrome (CRS) was diagnosed in one newborn, whose mother had contracted a disease abroad during pregnancy, with symptoms similar to rubella. The other four findings were detected in adults in the same workplace, who were born before the introduction of large-scale MMR vaccinations, and were therefore most probably unvaccinated.

## VARICELLA VIRUS

The number of varicella findings reported to the National Infectious Diseases Register was 505 in 2015, which corresponds to the level of the two previous years (2013: 455, 2014: 476). Of these findings, 208 were diagnosed by antigen detection, 160 by nucleic acid detection, 165 by serological diagnostics and one by direct microscopy. There were 36 (7.1%) reports based on a diagnosis from cerebrospinal fluid, involving the identification of nucleic acid in 32 cases, antibodies in eight and antigen in two cases.

Virus findings were reported among all age groups, the youngest being one month and the oldest 94 years old. Childhood varicella or chicken pox is a very common disease, with an estimated 57,000 cases in Finland every year. In most cases, it is diagnosed on the basis of symptoms and does not result ina laboratory sample being taken. In contrast, herpes zoster, or shingles, caused by the varicella virus being reactivated, is common, particularly in the elderly and requires the use of health care services, which can be seen in the age distribution of the virus findings. The incidence of varicella virus amongst the entire population was 9.2/100,000 on average, but in the 70 to 74 age group it is 10.1/100,000 and 14.9/100,000 in the age group of 75 and over.

Varicella vaccination is currently recommended for persons in close contact with immunocompromised

individuals and everyone aged 13 or over who has not had the chicken pox. A vaccine for herpes zoster, which prevents the later reactivation of the varicella virus, became available on the market in 2015.

## BORRELIA (LYME DISEASE)

In 2015, the number of reported cases of borrelia totalled 1,912, an all-time record. Of these reports, 37 were based on nucleic acid detection and 1,899 on a serological test. Cases were reported in all parts of the country. The average incidence was 35/100,000, but there was considerable regional variation. As in previous years, the incidence was highest in the Åland (1,981/100,000), the 573 cases diagnosed there accounting for almost a third of all cases of Borrelia in Finland. As before, the frequency of borrelia was highest in the autumn, the majority of cases occurring from August to October. The majority of cases (76%) were diagnosed in patients aged 45 and over. No differences between gender were diagnosed.

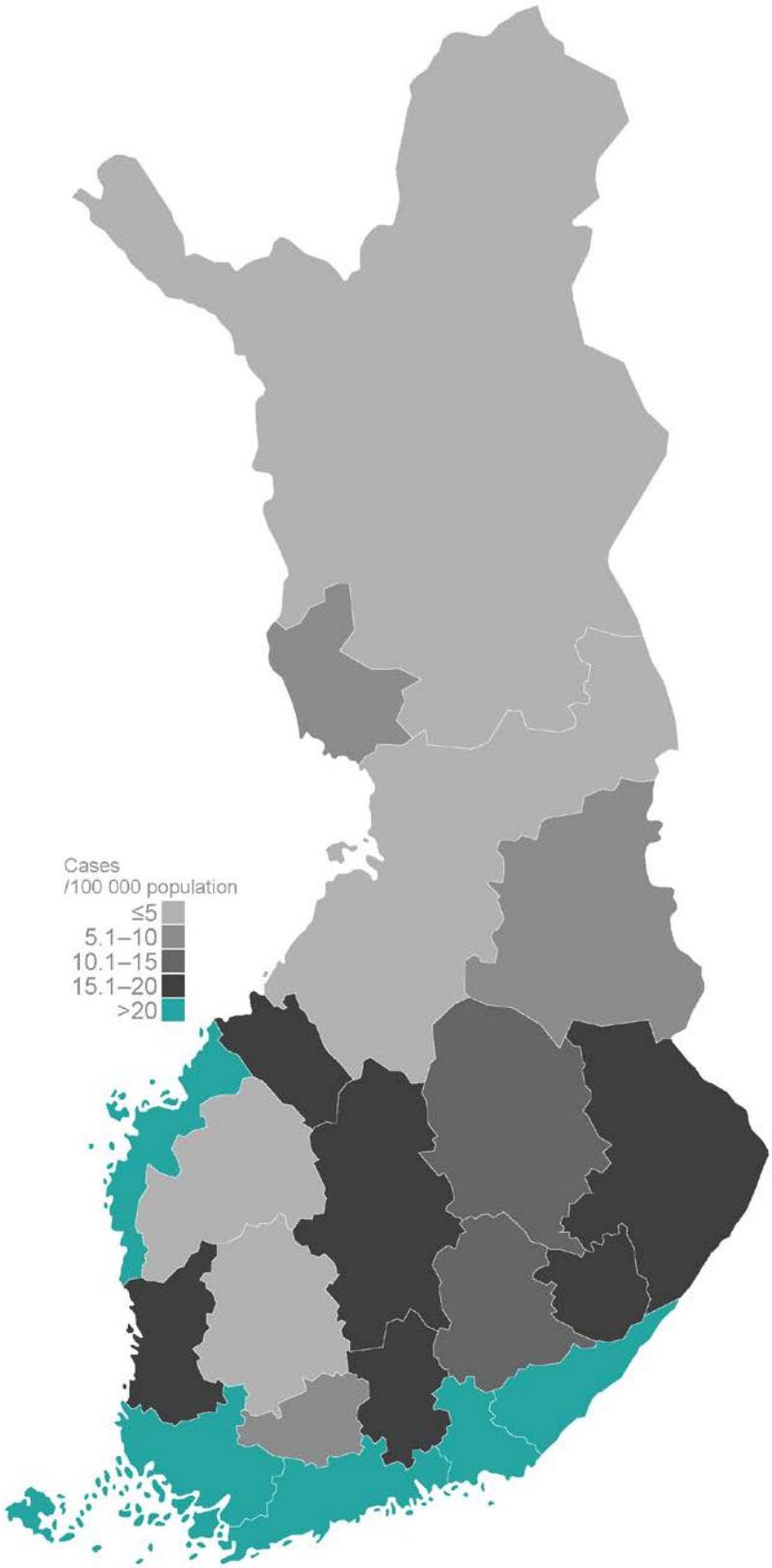


**Figure 20. Incidence of Borrelia (cases/100,000 population) by hospital district, 2015.**

## TICK-BORNE ENCEPHALITIS (TBE)

In 2015, a record number of TBE antibody findings were reported to the National Infectious Diseases Register, 67. Positive findings were diagnosed in April–November, mainly in August. Patients who contracted TBE were aged between 5 and 87 (average age 49) and two of them died.

In order to identify the place of acquisition, the National Institute for Health and Welfare interviewed patients who had been diagnosed with TBE and/or studied their patient records. Fourteen patients contracted TBE on Åland, 50 in mainland Finland and, in the case of three individuals, the place of infection remained unclear. All residents of Åland have been entitled to a TBE vaccination free of charge since 2006.

In mainland Finland, most TBE infections were contracted in known risk areas: the Turku archipelago (18), of which twelve occurred in Parainen; the Lappeenranta region (7), of which four occurred in the Sammonlahti area; the Kemi region (3); the Kotka archipelago (8) and the Kuopio region (2, a new place of acquisition being Kaavi). Other places of infection included Inkoo, Espoo, Raseborg and Pyhäjoki. Porkkala, Oulu, Ilomantsi, Muurame, the Rauma archipelago and Vierumäki emerged as new potential areas of infection, as a single infection was diagnosed in each of them.

The TBE virus was identified in ticks not only on Åland, but also in the Turku archipelago and the Lappeenranta region decades ago, and in collections performed in the following risk areas in recent years: Isosaari in Helsinki, the Kokkola archipelago and Maksniemi in Simo.

If a patient falls ill with meningitis or encephalitis between May and November, even if he or she has not noticed a tick bite TBE should be suspected, especially if the case occurs in a known high-risk area. Because new endemic TBE regions may continue to emerge, the possibility of TBE infection should be considered even beyond currently known risk areas.

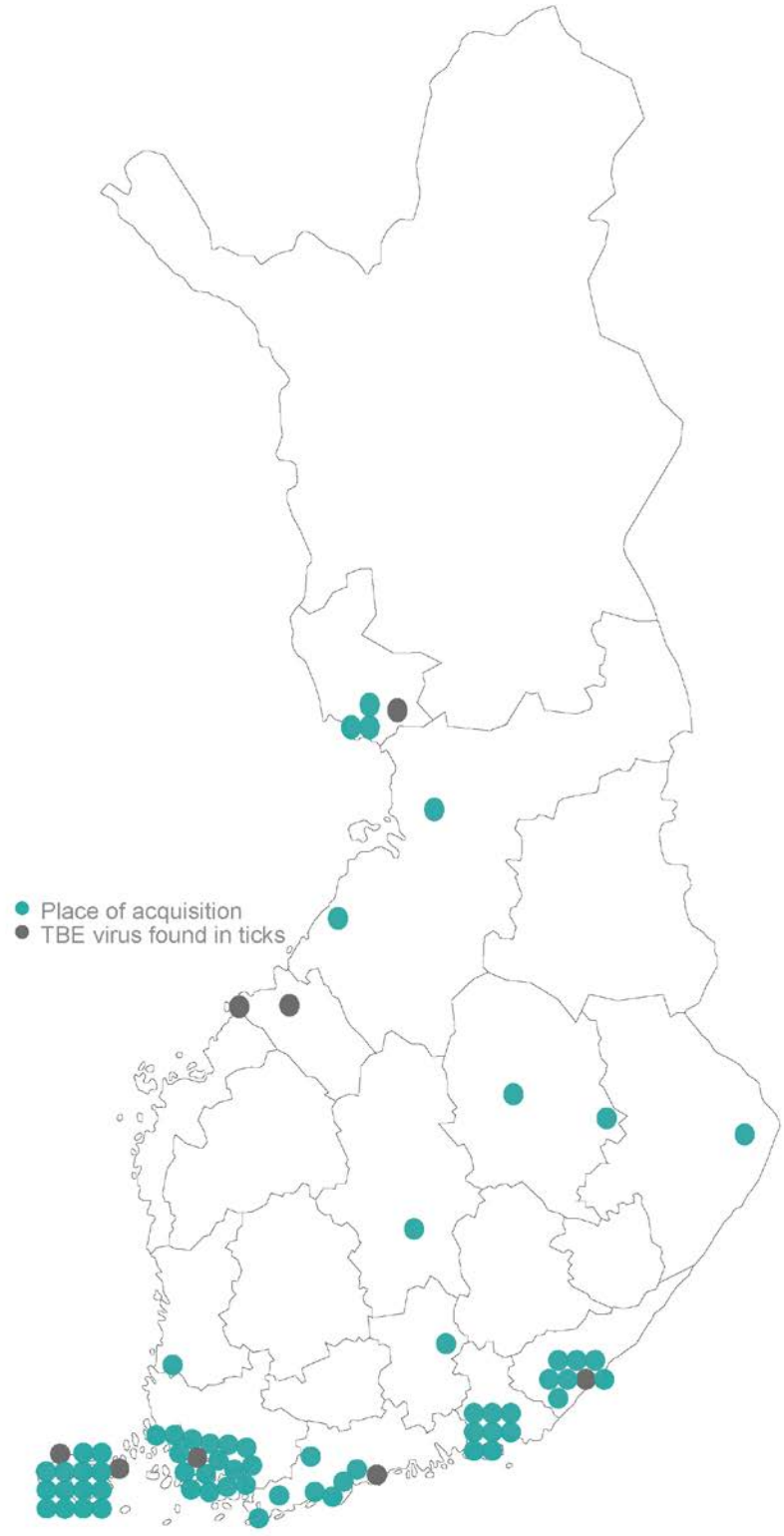


**Figure 21. Cases of TBE by location of acquisition, 2015, and TBE virus findings in ticks, 1996–2015.**

## PUUMALA VIRUS

In 2015, a total of 1,463 cases of Puumala virus infection were reported (26.8/100,000), less than in 2014 (2,087). The incidence of the virus varies depending on the virus reservoir, i.e. the size of the bank vole population, following a three or four year cycle, in accordance with the geographical region. The previous peaks occurred in 2005, 2008, 2011 and 2014. Of the patients, 60% were men and most patients were of working age. 31 (2.1%) cases occurred in patients under 20 years of age. The incidence was highest in the Kainuu (133/100,000) and Central Ostrobothnia hospital district (85/100,000).

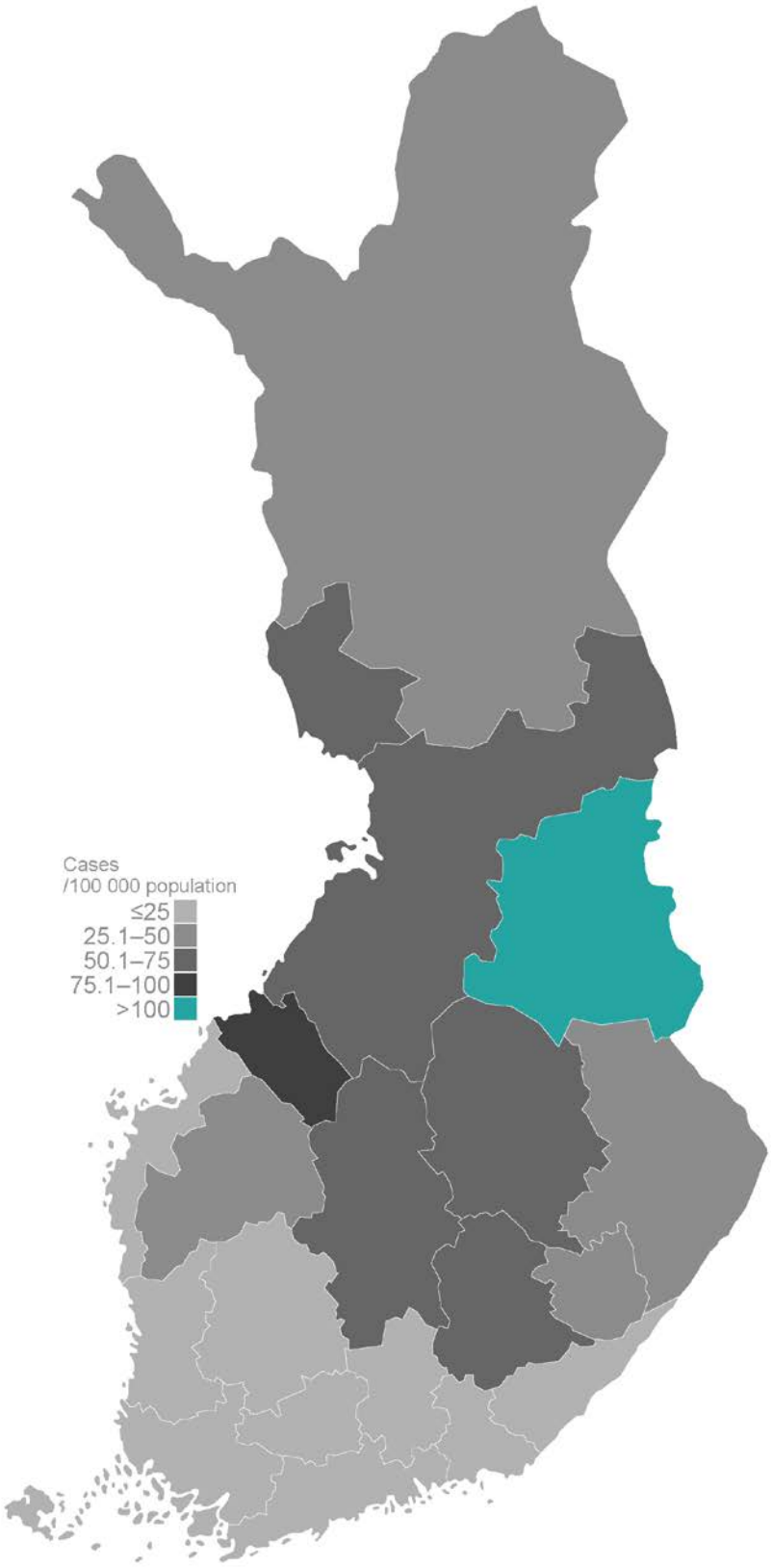


**Figure 22. Incidence of Puumala virus (cases/100,000 population) by hospital district, 2015.**

## POGOSTA DISEASE (SINDBIS VIRUS)

In 2015, 15 cases of Pogosta disease, confirmed with antibody testing, were diagnosed in Finland, which was the lowest on record during the register-based monitoring of the disease and considerably less than last year (32). The incidence was highest in the North Ostrobothnia Hospital District (1.2/100,000). Only one case was confirmed in the North Karelia Hospital District, historically a high incidence area. Of the patients, all were of working age (15–64), 73% were women and 60% of the cases were diagnosed in August–September.

Since 1974, Pogosta disease has followed a regular seven-year cycle, except in 2009. The epidemic peaked in 1981, 1995 and 2002; in 2009, however, only 106 cases were reported (2/100,000).

## TULAREMIA (FRANCISELLA TULARENSIS)

In 2015, the number of tularemia cases reported, 104 (incidence 1.9/100,000), was significantly higher than in 2014 (n=9) or 2013 (n=15), but fewer than in the peak years in the past. Most cases (82/104) were diagnosed in August–September and the other reports were submitted individually in different months. The annual incidence of tularemia varies considerably (between 0.2 and 18/100,000) and local epidemics break out every few years, particularly in the regions of Ostrobothnia and Central Finland.

## RABIES

Doctors are required to report cases where risk assessment after exposure has led to the administration of a course of rabies vaccinations and, possibly, rabies immunoglobulin treatment. In 2015, 40 reports were made, fewer than in 2014 (53).

The number of patients who had been exposed while travelling abroadwas 32 (78 %): 11 in Thailand, two in Indonesia, two in the Philippines, two in India and two in Russia. Others were individual cases of exposure in different countries.

More than half (19/32) of the cases of exposure abroad were related to a dog bite, six to a monkey bite and the others to contacts with cats, bats or hedgehogs.

Eight cases of exposure in Finland were reported, four related to bats and the others to contacts with a cat, dog, bear or weasel. No cases of exposure to rabies bait vaccine were reported in 2015.

## DIPHTHERIA (CORYNEBACTERIUM DIPHTHERIAE)

One case of diphtheria was diagnosed in 2015 in an unvaccinated asylum seeker, who arrived from Sweden and came originally from Afghanistan. The latest diagnosed case of diphtheria in Finland was in 2001.

## RELAPSING FEVER (BORRELIA RECURRENTIS)

In 2015, two individuals were diagnosed with relapsing fever caused by the bacterium *Borrelia recurrentis*. Both persons were asylum seekers, originally from Africa.

## TRAVEL-RELATED INFECTIONS

### Malaria

Malaria was diagnosed in 38 patients in Finland in 2015. There were 31 cases of *Plasmodium falciparum*, plus one *P. falciparum* and *P. vivax* double infection, one *P. vivax*, four cases of *P. ovale* and one *P. malariae* infection. All malaria cases originated in Africa. Of the patients, 18 (47%) were immigrants from a malaria area who had returned to visit their former home region; 10 (26%) were immigrants who had fallen ill immediately after arriving in Finland, and three were visitors to Finland. Five of the patients were native Finns who had taken a trip of less than six months to a malaria region, and two were Finns residing in a malaria region. None of the patients who fell ill had used the appropriate prophylaxis. One person born in Europe died from *P. falciparum* malaria, not having sought treatment after the symptoms appeared. The only symptom in two African women diagnosed with malaria caused by *P. falciparum* was severe anaemia during pregnancy.

**Table 18. Malaria cases in Finland in 2015 by country of acquisition.**

| Continent | Country | Cases |
|---|---|---|
| Africa | Burkina Faso | 1 |
| | Eritrea | 1 |
| | South Sudan | 4 |
| | Ethiopia | 1 |
| | Ghana | 5 |
| | Cameroon | 8 |
| | Kenya | 3 |
| | Central African Republic | 1 |
| | Democratic Republic of the Kongo | 1 |
| | Nigeria | 3 |
| | Rwanda | 1 |
| | Zambia | 2 |
| | Sierra Leone | 1 |
| | Somalia | 4 |
| | Uganda | 2 |
| | Total | 38 |

### Dengue fever

The annual number of dengue fever infections has varied between 35 and 90. In 2015, laboratories reported 54 findings; the majority of which (47/54) occurred in the age group 15 to 59. Diagnoses were made at all times of the year. Of the infections, 22 were reported as having been contracted in Asia (Thailand 11, Indonesia 6, India 2, the Philippines 2, the Maldives 1), one in Australia and one in South America (Brazil). Information on the country of acquisition is not available in all cases.

### Chikungunya

In 2015, laboratories reported seven findings of Chikungunya. In the previous year, there were four cases. In 2015, approximately 650,000 infections caused by the chikungunya virus were reported in the Caribbean and Americas, clearly fewer than in 2014. Outbreaks of minor epidemics were also reported in the Pacific islands. Information on the country of acquisition is not available in all cases.

## OTHER TRAVEL-RELATED INFECTIONS

A significant percentage of the following infections are travel-related: legionella, salmonella, campylobacter, shigella, EHEC, hepatitis A, hepatitis B, gonorrhoea, syphilis, HIV and AIDS, carbapenem-resistant gram-negative bacilli, MMR diseases and exposure to rabies. Data on the country of acquisition and means of transmission is discussed separately for each of these diseases in the respective section of this report.

## BLOOD AND CEREBROSPINAL FLUID FINDINGS IN CHILDREN

### Blood culture findings in children

In 2014, 461 cases of bacterial findings were diagnosed in blood cultures from children under 15 years of age. In comparison with previous years, the number has remained largely unchanged (in 2006–2014, 562 on average, variation 439–681).

Approximately one half of the findings (233 out of 461) were in babies under 12 months of age. Among infants, *Staphylococcus epidermidis* and other coagulase-negative staphylococci caused 36% of blood culture positive infections (table 19). Although these bacteria belong to normal skin flora, they typically cause treatment-related late-onset sepsis in newborn babies in intensive care. *Streptococcus agalactiae* (Group B streptococcus, GBS), typically contracted from the mother's birth canal during labour and causing an infection (early-onset sepsis) in the newborn baby during its first days of life, caused 11% of the findings. Other common causes of infection were *Escherichia coli* (16% of the findings), *Staphylococcus aureus* (12%), *Enterococcus faecalis* (4%) and *Streptococcus pneumoniae* (3%).

In the age group of 1 to 14 years, *S. aureus* (24%) was the most common cause of blood culture positive infections in 2015 (table 20). The number of *S. pneumoniae* findings decreased quickly after the introduction of a pneumococcus vaccination to the national vaccination programme in 2010 and, in recent years, the figure has been less than half of the preceding level, at 15% in 2015. Other findings in this age group were coagulase-negative staphylococci (21%), *E. coli* (9%), *Streptococcus pyogenes* (*6%) and the Streptococcus viridans* group (3%).

Fungal findings are rare in children's blood cultures, but in 2015, *Candida albicans* was diagnosed in the blood culture samples of three children aged 0–2 years.

## Cerebrospinal fluid findings in children

The number of cerebrospinal fluid findings related to children's central nervous system infections remained on a par with previous years, as did the distribution of pathogens. The total number of cases reported in 2015 was 30 (the annual average from 2006 to 2014 was 30, variation 22–37), of which six were diagnosed in under 12 month old infants.

Bacteria found in the under 12 month age group included *S. agalactiae, E. coli* and *S. aureus* (table 21), and in the age group 1 to 14 years, *Neisseria meningitidis, S. pneumoniae,* staphylococci and *Enterococcus faecalis* (table 22). There were no fungal findings in cerebrospinal fluid samples.

## GBS in newborns

Between 1995 and 2014, an average of 31 cases per year of early-onset GBS in newborns (diagnosed from blood and/or cerebrospinal fluid in children under the age of 7 days) were reported; the variation was 17 to 57 cases per year, and the incidence was 0.3 to 1.0 per 1,000 live births. In 2015, the number of cases was the lowest on record at only 13 (0.2/1000 live births). This is probably due to improved preventive practices. The majority of early-onset GBS cases can be prevented by administering an antimicrobial prophylaxis to mothers whose GBS colonisation puts the newborn at risk of a GBS infection. An average of 15 annual cases of late GBS disease cases detected at the age of more than 7 days have occurred during the fifteen-year surveillance period (range 6–24; incidence 0.1–0.4 cases per 1,000 live births). There were 11 cases in 2015 (0.2 cases per 1,000 live births). Antimicrobial prophylaxis during labour does not prevent early-onset GBS in newborns.

**Table 19. Blood culture findings in infants (under 12 months), 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Staphylococcus epidermidis | 100 | 92 | 87 | 64 | 70 | 75 | 50 | 62 | 46 | 49 |
| Escherichia coli | 44 | 42 | 38 | 37 | 45 | 48 | 25 | 41 | 37 | 38 |
| Staphylococcus, other coagulase-negative | 42 | 43 | 33 | 43 | 32 | 35 | 26 | 33 | 45 | 34 |
| Staphylococcus aureus | 37 | 25 | 23 | 22 | 24 | 21 | 31 | 22 | 20 | 28 |
| Streptococcus agalactiae | 55 | 51 | 49 | 51 | 54 | 42 | 36 | 33 | 31 | 26 |
| Enterococcus faecalis | 22 | 8 | 5 | 10 | 20 | 12 | 15 | 16 | 9 | 10 |
| Streptococcus viridans group | 9 | 9 | 8 | 9 | 17 | 13 | 6 | 8 | 8 | 9 |
| Enterobacter species | 13 | 8 | 6 | 3 | 3 | 10 | 5 | 4 | 2 | 7 |
| Streptococcus pneumoniae | 27 | 21 | 26 | 25 | 20 | 11 | 8 | 8 | 6 | 6 |
| Bacillus | 1 | 4 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 5 |
| Serratia species | 2 | 3 | 4 | 1 | 2 | 4 | 0 | 1 | 0 | 4 |
| Pseudomonas aeruginosa | 0 | 0 | 2 | 0 | 2 | 1 | 0 | 0 | 0 | 3 |
| Klebsiella species | 8 | 6 | 7 | 9 | 3 | 7 | 6 | 6 | 4 | 3 |
| Streptococcus, other beta-haemolytic | 3 | 0 | 0 | 4 | 2 | 0 | 1 | 1 | 1 | 1 |
| Neisseria meningitidis | 2 | 3 | 3 | 5 | 4 | 1 | 2 | 4 | 3 | 1 |
| Haemophilus influenzae | 1 | 1 | 2 | 2 | 1 | 0 | 4 | 1 | 2 | 1 |
| Bacteroides, other than fragilis group | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Yersinia enterocolitica | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Salmonella, other than Typhi or Paratyphi | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| Streptococcus pyogenes | 0 | 3 | 2 | 4 | 2 | 0 | 6 | 1 | 2 | 0 |
| Streptococcus milleri group | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Streptococcus bovis group | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Enterococcus, other or unidentified | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 0 |
| Enterococcus faecium | 3 | 0 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 0 |
| Propionibacterium species | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Mycobacterium species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Listeria monocytogenes | 2 | 1 | 0 | 1 | 2 | 0 | 1 | 1 | 1 | 0 |
| Clostridium, other than perfringens | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Peptostreptococcus and Peptococcus | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Stenotrophomonas maltophilia | 0 | 2 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| Haemophilus, other than influenzae | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Acinetobacter | 3 | 2 | 1 | 1 | 3 | 2 | 1 | 2 | 0 | 0 |
| Veillonella species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prevotella species | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bacteroides fragilis group | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Pseudomonas, other than aeruginosa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Proteus mirabilis | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Citrobacter species | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 |
| Other bacteria | 8 | 7 | 7 | 5 | 5 | 9 | 8 | 3 | 6 | 5 |
| Total | 388 | 334 | 311 | 307 | 319 | 295 | 237 | 250 | 228 | 233 |
| Candida albicans | 4 | 2 | 3 | 1 | 2 | 1 | 1 | 2 | 3 | 2 |
| Other candida species | 0 | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 0 |
| Total | 4 | 4 | 4 | 1 | 2 | 2 | 3 | 2 | 4 | 2 |

**Table 20. Blood culture findings in children (aged 1 to 14), 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Staphylococcus aureus | 37 | 42 | 40 | 36 | 43 | 42 | 47 | 48 | 40 | 54 |
| Streptococcus pneumoniae | 100 | 115 | 87 | 92 | 95 | 74 | 35 | 35 | 32 | 27 |
| Staphylococcus epidermidis | 40 | 33 | 22 | 31 | 37 | 29 | 17 | 25 | 28 | 26 |
| Staphylococcus, other coagulase-negative | 8 | 19 | 13 | 17 | 21 | 13 | 11 | 9 | 19 | 23 |
| Escherichia coli | 16 | 12 | 14 | 12 | 15 | 11 | 14 | 9 | 17 | 20 |
| Streptococcus pyogenes | 9 | 13 | 11 | 11 | 6 | 15 | 9 | 8 | 14 | 13 |
| Streptococcus viridans group | 25 | 21 | 21 | 25 | 37 | 23 | 27 | 27 | 14 | 10 |
| Bacillus | 6 | 0 | 6 | 3 | 3 | 2 | 5 | 5 | 4 | 6 |
| Enterobacter species | 1 | 2 | 4 | 3 | 2 | 3 | 1 | 0 | 0 | 6 |
| Streptococcus, other beta-haemolytic | 3 | 4 | 0 | 2 | 3 | 1 | 1 | 1 | 1 | 4 |
| Enterococcus faecalis | 2 | 6 | 6 | 4 | 6 | 3 | 5 | 1 | 1 | 3 |
| Acinetobacter | 1 | 2 | 2 | 4 | 1 | 0 | 1 | 3 | 1 | 3 |
| Streptococcus milleri group | 2 | 0 | 2 | 2 | 2 | 1 | 1 | 0 | 2 | 2 |
| Streptococcus bovis group | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Mycobacterium species | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Peptostreptococcus and Peptococcus | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 1 |
| Neisseria meningitidis | 5 | 3 | 4 | 0 | 6 | 2 | 2 | 3 | 1 | 1 |
| Haemophilus, other than influenzae | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| Haemophilus influenzae | 1 | 2 | 3 | 3 | 2 | 5 | 0 | 3 | 5 | 1 |
| Bacteroides fragilis group | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 1 | 1 |
| Pseudomonas, other than aeruginosa | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 1 |
| Pseudomonas aeruginosa | 3 | 2 | 1 | 3 | 7 | 4 | 3 | 4 | 9 | 1 |
| Salmonella, other than Typhi or Paratyphi | 2 | 5 | 2 | 0 | 6 | 2 | 3 | 4 | 1 | 1 |
| Klebsiella species | 3 | 6 | 5 | 2 | 4 | 2 | 6 | 3 | 0 | 1 |
| Streptococcus agalactiae | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Enterococcus, other or unidentified | 2 | 2 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| Enterococcus faecium | 3 | 4 | 2 | 5 | 7 | 0 | 2 | 2 | 1 | 0 |
| Propionibacterium species | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Listeria monocytogenes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Corynebacterium diphteriae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Clostridium, other than perfringens | 0 | 1 | 1 | 1 | 4 | 4 | 1 | 1 | 2 | 0 |
| Clostridium perfringens | 1 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Stenotrophomonas maltophilia | 1 | 3 | 4 | 2 | 2 | 0 | 1 | 1 | 1 | 0 |
| Veillonella species | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Fusobacterium species | 3 | 5 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Serratia species | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| Salmonella Typhi | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 |
| Proteus mirabilis | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Citrobacter species | 0 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 3 | 0 |
| Other bacteria | 14 | 15 | 10 | 13 | 24 | 11 | 14 | 9 | 12 | 20 |
| Total | 293 | 328 | 271 | 278 | 339 | 255 | 211 | 208 | 211 | 228 |
| Candida albicans | 1 | 0 | 2 | 0 | 2 | 0 | 1 | 2 | 1 | 1 |
| Other candida species | 3 | 3 | 1 | 0 | 0 | 3 | 0 | 1 | 0 | 1 |
| Total | 4 | 3 | 3 | 0 | 2 | 3 | 1 | 3 | 1 | 2 |

**Table 21. Cerebrospinal fluid culture findings in infants (under 12 months), 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Streptococcus agalactiae | 8 | 8 | 3 | 6 | 10 | 3 | 4 | 1 | 7 | 3 |
| Escherichia coli | 2 | 1 | 1 | 1 | 2 | 1 | 0 | 0 | 2 | 2 |
| Staphylococcus aureus | 0 | 1 | 2 | 2 | 1 | 0 | 3 | 2 | 1 | 1 |
| Streptococcus viridans group | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 |
| Streptococcus pyogenes | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Streptococcus pneumoniae | 1 | 4 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 0 |
| Enterococcus faecium | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Enterococcus faecalis | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Staphylococcus, other coagulase-negative | 0 | 0 | 4 | 1 | 0 | 0 | 2 | 0 | 0 | 0 |
| Staphylococcus epidermidis | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 2 | 0 |
| Propionibacterium species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Mycobacterium species | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Bacillus | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Neisseria meningitidis | 1 | 2 | 1 | 2 | 1 | 0 | 3 | 3 | 2 | 0 |
| Haemophilus influenzae | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| Acinetobacter | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bacteroides, other than fragilis group | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Klebsiella species | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| Citrobacter species | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| Other bacteria | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| Total | 20 | 21 | 15 | 22 | 21 | 9 | 15 | 12 | 21 | 6 |
| Candida albicans | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 22. Cerebrospinal fluid culture findings in children (aged 1 to 14), 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Staphylococcus epidermidis | 0 | 1 | 5 | 2 | 1 | 2 | 1 | 0 | 3 | 3 |
| Streptococcus viridans group | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Propionibacterium species | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 |
| Neisseria meningitidis | 7 | 6 | 3 | 2 | 3 | 4 | 2 | 3 | 1 | 2 |
| Streptococcus pneumoniae | 5 | 5 | 2 | 4 | 2 | 3 | 0 | 4 | 2 | 1 |
| Enterococcus faecalis | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Staphylococcus, other coagulase-negative | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| Staphylococcus aureus | 0 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 0 | 1 |
| Streptococcus, other beta-haemolytic | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Peptostreptococcus and Peptococcus | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Haemophilus influenzae | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| Bacteroides fragilis group | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Enterobacter species | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| Other bacteria | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| Total | 17 | 14 | 15 | 15 | 10 | 13 | 8 | 10 | 9 | 14 |

## BLOOD AND CEREBROSPINAL FLUID FINDINGS IN ADULTS

### Blood culture findings in adults

In 2015, the total number of bacterial findings in adults' blood culture samples was 14,599. The number of findings has increased continuously, particularly the percentage diagnosed in the over 65 age group (68%, 9,917/14,599). Gram-positive bacteria were more common in the working-age population (aged 15 to 64) and gram-negative bacteria among those aged 65 or more. The number of fungi in adults' blood cultures was on a par with previous years, totalling 216 findings.

In both the working-age population (24% of all findings) and the over 65 age group (34%), the most common bacterial finding in blood was *Escherichia coli*. Other common bacterial findings included (tables 24 and 25) *Staphylococcus aureus* (working age 17%, over 65s 12%), coagulase-negative staphylococci (working age 10%, over 65 8%), *Streptococcus pneumoniae* (working age 7%, over 65s 4%) and *Klebsiella* species (working age 4%, over 65s 7%). An estimated, one half of the *Staphylococcus aureus* findings were related to treatment, as were almost all of the coagulase-negative staphylococci. Anaerobic bacteria constituted around 4% of all blood culture positive findings among adults.

### Cerebrospinal fluid findings in adults

In 2015, the total number of microbial findings in adults' cerebrospinal fluid was 142, which corresponds to the 2006–2014 average. Patients over the age of 65 accounted for 30% of cases.

In the working-age population, coagulase-negative staphylococci accounted for 31% of the findings

(table 26). The most common actual pathogens were *S. pneumoniae* (17%) and *S. aureus* (14%). In patients aged 65 years or older, the most common findings were *S. pneumoniae* (29%), *Listeria monocytogenes* (14%), *Propionibacterium* species (12%), coagulase-negative staphylococci (12%) and *S. aureus* (10%) (table 27).

## Group A streptococcus

In 2015, the number of invasive infections of Group A streptococcus (*Streptococcus pyogenes*) increased slightly in comparison with the previous year (2015: 178 cf. 2014: 211). The two most prevalent *emm* types, *emm*28 and *emm*89, were the same as previously. In earlier years, the numbers of the common emm1 type increased after a decrease in the previous year (2015: 19, 11% cf. 2014: 10.5%). The numbers of macrolide-resistant type *emm*33 began to decline (2; 1%). In addition to the aforementioned, the percentages of emm types *emm12* (8; 5%) and *emm66* (6; 3%) have remained the same. Although new emm types are continuously emerging, the four most common emm types – *emm28*, *emm89*, *emm1* and *emm4* – accounted for 74% of all emm types in 2015.

**Table 23. Group A streptococcus blood findings by emm type, 2006–2015 (no. of cases and %).**
Each emm type includes all variants detected.

| Year | Analysed strains | emm1 | emm28 | emm4 | emm89 | emm33 | Others |
|---|---|---|---|---|---|---|---|
| 2006 | 162 | 26 (16%) | 33 (20%) | 1 (1%) | 11 (7%) | 0 (0%) | 91 (56%) |
| 2007 | 205 | 57 (28%) | 26 (13%) | 7 (3%) | 12 (6%) | 0 (0%) | 103 (50%) |
| 2008 | 218 | 51 (23%) | 46 (21%) | 4 (2%) | 10 (5%) | 0 (0%) | 107 (49%) |
| 2009 | 191 | 24 (13%) | 56 (29%) | 8 (4%) | 28 (15%) | 0 (0%) | 75 (39%)* |
| 2010 | 171 | 22 (13%) | 38 (22%) | 6 (4%) | 24 (14%) | 0 (0%) | 81 (47%) |
| 2011 | 161 | 24 (15%) | 37 (23%) | 6 (4%) | 30 (19%) | 0 (0%) | 64 (40%) |
| 2012 | 207 | 22 (11%) | 65 (31%) | 13 (6%) | 58 (28%) | 5 (2%) | 44 (21%) |
| 2013 | 176 | 18 (10%) | 58 (33%) | 11 (6%) | 43 (24%) | 13 (7%) | 33 (19%) |
| 2014 | 205 | 10 (5%) | 62 (30%) | 17 (8%) | 47 (23%) | 12 (6%) | 57 (28%) |
| 2015 | 173 | 19 (11%) | 60 (35%) | 15 (9%) | 33 (19%) | 2 (1%) | 44 (25%)* |

* One untyped finding in 2009 and 2015.

**Table 24. Blood culture findings in patients aged 15 to 64, 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Escherichia coli | 797 | 837 | 872 | 884 | 931 | 934 | 942 | 951 | 1070 | 1113 |
| Staphylococcus aureus | 565 | 544 | 526 | 540 | 579 | 641 | 617 | 644 | 800 | 786 |
| Streptococcus pneumoniae | 348 | 352 | 480 | 440 | 412 | 391 | 363 | 356 | 307 | 350 |
| Staphylococcus epidermidis | 281 | 265 | 278 | 312 | 263 | 223 | 182 | 210 | 240 | 270 |
| Staphylococcus, other coagulase-negative | 128 | 147 | 156 | 136 | 140 | 144 | 104 | 154 | 191 | 209 |
| Klebsiella species | 144 | 157 | 185 | 186 | 207 | 164 | 217 | 220 | 218 | 206 |
| Streptococcus, other beta-haemolytic | 135 | 129 | 128 | 122 | 139 | 154 | 133 | 177 | 173 | 156 |
| Streptococcus milleri group | 63 | 65 | 73 | 56 | 68 | 86 | 79 | 98 | 127 | 128 |
| Bacteroides fragilis group | 85 | 82 | 109 | 68 | 110 | 108 | 103 | 101 | 132 | 125 |
| Streptococcus agalactiae | 76 | 83 | 96 | 95 | 110 | 75 | 89 | 96 | 89 | 113 |
| Enterococcus faecalis | 83 | 105 | 83 | 107 | 86 | 97 | 102 | 83 | 99 | 110 |
| Streptococcus viridans group | 130 | 115 | 137 | 144 | 147 | 156 | 150 | 149 | 129 | 108 |
| Streptococcus pyogenes | 105 | 133 | 157 | 116 | 113 | 104 | 126 | 105 | 122 | 99 |
| Enterobacter species | 77 | 70 | 69 | 81 | 99 | 86 | 96 | 90 | 85 | 97 |
| Pseudomonas aeruginosa | 62 | 72 | 74 | 78 | 91 | 92 | 79 | 91 | 74 | 81 |
| Enterococcus faecium | 64 | 80 | 91 | 87 | 85 | 101 | 89 | 96 | 103 | 72 |
| Bacillus | 22 | 24 | 25 | 21 | 32 | 34 | 27 | 42 | 60 | 54 |
| Serratia species | 18 | 19 | 24 | 27 | 20 | 32 | 26 | 32 | 31 | 39 |
| Fusobacterium species | 19 | 31 | 31 | 27 | 37 | 32 | 48 | 41 | 47 | 37 |
| Peptostreptococcus and Peptococcus | 18 | 11 | 12 | 27 | 15 | 30 | 18 | 22 | 38 | 36 |
| Proteus mirabilis | 18 | 14 | 14 | 18 | 26 | 17 | 24 | 22 | 23 | 32 |
| Clostridium, other than perfringens | 25 | 18 | 24 | 29 | 23 | 20 | 32 | 29 | 43 | 30 |
| Citrobacter species | 27 | 19 | 23 | 29 | 31 | 28 | 25 | 23 | 35 | 30 |
| Campylobacter species | 3 | 8 | 7 | 11 | 10 | 4 | 6 | 8 | 33 | 26 |
| Salmonella, other than Typhi or Paratyphi | 47 | 52 | 43 | 23 | 39 | 32 | 32 | 36 | 28 | 25 |
| Haemophilus influenzae | 9 | 26 | 18 | 19 | 18 | 22 | 25 | 23 | 18 | 22 |
| Stenotrophomonas maltophilia | 7 | 5 | 15 | 12 | 12 | 9 | 7 | 14 | 16 | 20 |
| Acinetobacter | 10 | 21 | 13 | 18 | 14 | 21 | 14 | 11 | 15 | 18 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Enterococcus, other or unidentified | 6 | 4 | 7 | 13 | 13 | 12 | 20 | 8 | 5 | 13 |
| Morganella morganii | 8 | 7 | 14 | 8 | 6 | 8 | 7 | 18 | 12 | 13 |
| Clostridium perfringens | 11 | 12 | 10 | 16 | 15 | 8 | 11 | 8 | 13 | 12 |
| Neisseria meningitidis | 20 | 21 | 9 | 13 | 14 | 17 | 12 | 5 | 10 | 12 |
| Capnocytophaga canimorsus | 8 | 8 | 8 | 11 | 11 | 17 | 13 | 14 | 15 | 12 |
| Pseudomonas, other than aeruginosa | 0 | 3 | 5 | 6 | 6 | 8 | 8 | 8 | 14 | 11 |
| Prevotella species | 11 | 8 | 13 | 13 | 15 | 16 | 16 | 10 | 12 | 10 |
| Listeria monocytogenes | 10 | 9 | 8 | 9 | 15 | 7 | 17 | 11 | 18 | 9 |
| Streptococcus bovis group | 5 | 7 | 1 | 6 | 7 | 6 | 6 | 4 | 5 | 8 |
| Propionibacterium species | 7 | 5 | 3 | 9 | 6 | 9 | 7 | 9 | 11 | 8 |
| Haemophilus, other than influenzae | 3 | 3 | 3 | 0 | 2 | 3 | 10 | 5 | 6 | 8 |
| Veillonella species | 3 | 4 | 3 | 6 | 5 | 12 | 6 | 8 | 9 | 5 |
| Bacteroides, other than fragilis group | 4 | 3 | 5 | 10 | 1 | 7 | 3 | 7 | 8 | 5 |
| Proteus vulgaris | 7 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 4 | 4 |
| Mycobacterium species | 4 | 5 | 2 | 2 | 2 | 4 | 3 | 8 | 3 | 3 |
| Yersinia enterocolitica | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| Salmonella Paratyphi | 3 | 6 | 6 | 3 | 3 | 1 | 3 | 1 | 2 | 2 |
| Hafnia alvei | 0 | 1 | 3 | 6 | 2 | 2 | 2 | 1 | 2 | 2 |
| Salmonella Typhi | 3 | 4 | 1 | 3 | 9 | 2 | 1 | 5 | 5 | 1 |
| Corynebacterium diphteriae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Yersinia pseudotuberculosis | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| Other bacteria | 92 | 78 | 94 | 107 | 92 | 99 | 111 | 130 | 156 | 150 |
| Total | 3,571 | 3,676 | 3,961 | 3,958 | 4,084 | 4,077 | 4,015 | 4,187 | 4,657 | 4,682 |
| Other candida species | 22 | 26 | 41 | 29 | 37 | 34 | 31 | 45 | 44 | 50 |
| Candida albicans | 54 | 54 | 55 | 55 | 57 | 74 | 56 | 64 | 53 | 47 |
| Other fungi | 2 | 4 | 2 | 3 | 1 | 3 | 2 | 3 | 3 | 1 |
| Total | 78 | 84 | 98 | 87 | 95 | 111 | 89 | 112 | 100 | 98 |

**Table 25. Blood culture findings in patients aged 65 or over, 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Escherichia coli | 1,706 | 1,759 | 1,887 | 2,053 | 2,230 | 2,478 | 2,482 | 2,875 | 3,242 | 3,361 |
| Staphylococcus aureus | 601 | 568 | 671 | 691 | 728 | 780 | 797 | 876 | 1,065 | 1,184 |
| Klebsiella species | 326 | 339 | 375 | 462 | 469 | 471 | 537 | 556 | 664 | 729 |
| Streptococcus, other beta-haemolytic | 190 | 180 | 193 | 232 | 279 | 285 | 308 | 335 | 442 | 466 |
| Streptococcus pneumoniae | 270 | 290 | 326 | 294 | 303 | 295 | 342 | 319 | 355 | 426 |
| Staphylococcus epidermidis | 264 | 275 | 299 | 271 | 326 | 316 | 300 | 343 | 366 | 394 |
| Staphylococcus, other coagulase-negative | 132 | 144 | 171 | 161 | 149 | 162 | 170 | 252 | 293 | 367 |
| Enterococcus faecalis | 202 | 219 | 217 | 222 | 229 | 274 | 286 | 301 | 349 | 334 |
| Bacteroides fragilis group | 119 | 135 | 146 | 163 | 178 | 202 | 183 | 201 | 253 | 295 |
| Pseudomonas aeruginosa | 154 | 188 | 191 | 184 | 218 | 196 | 250 | 230 | 233 | 253 |
| Enterobacter species | 95 | 104 | 131 | 128 | 156 | 156 | 174 | 188 | 172 | 217 |
| Enterococcus faecium | 100 | 132 | 126 | 170 | 161 | 174 | 169 | 209 | 236 | 204 |
| Streptococcus viridans group | 110 | 113 | 140 | 135 | 132 | 168 | 175 | 191 | 161 | 162 |
| Streptococcus agalactiae | 81 | 77 | 93 | 104 | 126 | 113 | 117 | 129 | 170 | 162 |
| Proteus mirabilis | 68 | 92 | 99 | 102 | 106 | 97 | 130 | 116 | 156 | 150 |
| Streptococcus milleri group | 67 | 54 | 53 | 62 | 59 | 59 | 65 | 92 | 127 | 144 |
| Citrobacter species | 42 | 35 | 65 | 59 | 76 | 59 | 95 | 99 | 97 | 113 |
| Serratia species | 27 | 33 | 50 | 37 | 59 | 56 | 64 | 81 | 72 | 89 |
| Streptococcus pyogenes | 48 | 58 | 50 | 60 | 50 | 48 | 75 | 67 | 73 | 74 |
| Clostridium, other than perfringens | 30 | 33 | 30 | 38 | 44 | 38 | 45 | 39 | 60 | 69 |
| Clostridium perfringens | 36 | 39 | 34 | 49 | 40 | 51 | 56 | 34 | 57 | 61 |
| Peptostreptococcus and Peptococcus | 22 | 25 | 14 | 29 | 36 | 26 | 24 | 32 | 44 | 42 |
| Morganella morganii | 14 | 26 | 11 | 18 | 29 | 30 | 16 | 30 | 39 | 40 |
| Enterococcus, other or unidentified | 19 | 15 | 24 | 20 | 25 | 33 | 34 | 17 | 21 | 33 |
| Listeria monocytogenes | 25 | 26 | 26 | 20 | 45 | 30 | 36 | 45 | 43 | 32 |
| Haemophilus influenzae | 21 | 25 | 21 | 22 | 19 | 37 | 51 | 20 | 32 | 28 |
| Acinetobacter | 18 | 11 | 12 | 16 | 16 | 17 | 19 | 21 | 16 | 28 |
| Fusobacterium species | 9 | 15 | 10 | 8 | 17 | 14 | 19 | 18 | 22 | 26 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Streptococcus bovis group | 17 | 17 | 15 | 25 | 14 | 13 | 21 | 29 | 19 | 22 |
| Campylobacter species | 5 | 3 | 5 | 6 | 2 | 1 | 4 | 4 | 13 | 20 |
| Propionibacterium species | 9 | 4 | 5 | 9 | 10 | 13 | 6 | 7 | 12 | 18 |
| Prevotella species | 10 | 8 | 11 | 15 | 13 | 13 | 7 | 11 | 16 | 18 |
| Stenotrophomonas maltophilia | 10 | 8 | 3 | 6 | 7 | 4 | 8 | 12 | 7 | 16 |
| Proteus vulgaris | 9 | 9 | 4 | 4 | 8 | 8 | 12 | 14 | 16 | 15 |
| Pseudomonas, other than aeruginosa | 9 | 9 | 11 | 10 | 10 | 8 | 11 | 12 | 18 | 13 |
| Bacillus | 17 | 9 | 11 | 12 | 7 | 13 | 7 | 17 | 24 | 12 |
| Bacteroides, other than fragilis group | 3 | 5 | 8 | 13 | 8 | 8 | 16 | 12 | 10 | 11 |
| Capnocytophaga canimorsus | 4 | 2 | 3 | 2 | 2 | 6 | 7 | 12 | 9 | 9 |
| Hafnia alvei | 3 | 6 | 8 | 7 | 6 | 1 | 8 | 6 | 4 | 7 |
| Haemophilus, other than influenzae | 2 | 1 | 1 | 1 | 1 | 0 | 3 | 8 | 4 | 5 |
| Mycobacterium species | 5 | 1 | 4 | 0 | 5 | 1 | 1 | 1 | 2 | 4 |
| Veillonella species | 2 | 5 | 9 | 5 | 2 | 5 | 5 | 10 | 10 | 4 |
| Neisseria meningitidis | 5 | 2 | 6 | 6 | 6 | 6 | 5 | 4 | 2 | 3 |
| Salmonella, other than Typhi or Paratyphi | 11 | 8 | 19 | 6 | 8 | 7 | 13 | 9 | 14 | 3 |
| Salmonella Paratyphi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Corynebacterium diphteriae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Yersinia pseudotuberculosis | 1 | 1 | 0 | 3 | 1 | 0 | 1 | 0 | 0 | 0 |
| Yersinia enterocolitica | 1 | 1 | 0 | 1 | 1 | 0 | 3 | 0 | 0 | 0 |
| Salmonella Typhi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Other bacteria | 87 | 81 | 119 | 121 | 115 | 134 | 142 | 186 | 234 | 254 |
| Total | 5,006 | 5,190 | 5,707 | 6,062 | 6,531 | 6,906 | 7,299 | 8,070 | 9,274 | 9,918 |
| Candida albicans | 54 | 56 | 66 | 49 | 93 | 65 | 70 | 77 | 72 | 71 |
| Other candida species | 21 | 26 | 26 | 42 | 31 | 47 | 39 | 60 | 44 | 45 |
| Other fungi | 5 | 7 | 8 | 3 | 3 | 4 | 1 | 3 | 0 | 2 |
| Total | 80 | 89 | 100 | 94 | 127 | 116 | 110 | 140 | 116 | 118 |

**Table 26. Cerebrospinal fluid culture findings in patients aged 15 to 64, 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Staphylococcus epidermidis | 32 | 17 | 26 | 18 | 11 | 10 | 21 | 12 | 17 | 20 |
| Streptococcus pneumoniae | 17 | 13 | 27 | 20 | 15 | 12 | 19 | 13 | 11 | 17 |
| Staphylococcus aureus | 9 | 16 | 13 | 13 | 12 | 20 | 15 | 11 | 9 | 14 |
| Propionibacterium species | 5 | 5 | 4 | 4 | 7 | 4 | 5 | 6 | 13 | 12 |
| Staphylococcus, other coagulase-negative | 12 | 7 | 14 | 11 | 8 | 6 | 7 | 12 | 9 | 11 |
| Streptococcus agalactiae | 1 | 5 | 2 | 0 | 2 | 0 | 1 | 1 | 1 | 4 |
| Neisseria meningitidis | 20 | 16 | 4 | 9 | 6 | 7 | 6 | 1 | 1 | 3 |
| Listeria monocytogenes | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 3 |
| Acinetobacter | 3 | 5 | 2 | 3 | 0 | 2 | 2 | 0 | 1 | 2 |
| Enterococcus faecalis | 4 | 5 | 4 | 3 | 4 | 3 | 3 | 0 | 0 | 2 |
| Serratia species | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Pseudomonas aeruginosa | 6 | 3 | 4 | 5 | 3 | 1 | 4 | 1 | 2 | 1 |
| Mycobacterium species | 0 | 1 | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 1 |
| Enterobacter species | 2 | 2 | 9 | 3 | 1 | 2 | 4 | 2 | 2 | 1 |
| Citrobacter species | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| Bacillus | 6 | 4 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 1 |
| Haemophilus, other than influenzae | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 |
| Streptococcus, other beta-haemolytic | 0 | 0 | 1 | 2 | 1 | 2 | 1 | 0 | 1 | 0 |
| Streptococcus viridans group | 7 | 2 | 1 | 2 | 2 | 4 | 2 | 2 | 2 | 0 |
| Streptococcus pyogenes | 1 | 0 | 2 | 2 | 1 | 1 | 0 | 0 | 2 | 0 |
| Streptococcus milleri group | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Streptococcus bovis group | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Stenotrophomonas maltophilia | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Pseudomonas, other than aeruginosa | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| Proteus mirabilis | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Peptostreptococcus and Peptococcus | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Morganella morganii | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Klebsiella species | 2 | 1 | 4 | 2 | 1 | 2 | 0 | 1 | 5 | 0 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Escherichia coli | 4 | 3 | 3 | 4 | 1 | 1 | 2 | 1 | 1 | 0 |
| Capnocytophaga canimorsus | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| Campylobacter species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Bacteroides, other than fragilis group | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Salmonella, other than Typhi or Paratyphi | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Haemophilus influenzae | 0 | 0 | 3 | 1 | 0 | 2 | 1 | 2 | 3 | 0 |
| Enterococcus, other or unidentified | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Enterococcus faecium | 0 | 1 | 0 | 1 | 0 | 2 | 2 | 1 | 0 | 0 |
| Clostridium, other than perfringens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Other bacteria | 4 | 3 | 2 | 4 | 0 | 1 | 2 | 1 | 5 | 2 |
| Total | 139 | 116 | 136 | 112 | 78 | 92 | 104 | 70 | 92 | 97 |
| Other candida species | 2 | 3 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 2 |
| Candida albicans | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Total | 2 | 4 | 0 | 1 | 1 | 0 | 2 | 0 | 1 | 3 |

**Table 27. Cerebrospinal fluid culture findings in patients aged 65 or over, 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Streptococcus pneumoniae | 10 | 4 | 7 | 10 | 6 | 8 | 4 | 8 | 1 | 12 |
| Listeria monocytogenes | 3 | 2 | 2 | 2 | 6 | 4 | 4 | 4 | 4 | 6 |
| Propionibacterium species | 2 | 0 | 2 | 2 | 1 | 1 | 2 | 2 | 9 | 5 |
| Staphylococcus aureus | 3 | 2 | 3 | 6 | 5 | 5 | 2 | 10 | 4 | 4 |
| Staphylococcus, other coagulase-negative | 3 | 2 | 4 | 3 | 3 | 1 | 3 | 5 | 6 | 3 |
| Escherichia coli | 1 | 0 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 3 |
| Staphylococcus epidermidis | 9 | 12 | 10 | 6 | 3 | 4 | 7 | 8 | 8 | 2 |
| Streptococcus agalactiae | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| Mycobacterium species | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| Bacillus | 0 | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | 1 |
| Serratia species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Citrobacter species | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| Streptococcus, other beta-haemolytic | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| Streptococcus viridans group | 1 | 1 | 0 | 3 | 1 | 0 | 3 | 1 | 0 | 0 |
| Streptococcus pyogenes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Streptococcus milleri group | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Streptococcus bovis group | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Enterococcus, other or unidentified | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Enterococcus faecium | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Enterococcus faecalis | 2 | 3 | 0 | 1 | 0 | 0 | 2 | 0 | 2 | 0 |
| Corynebacterium diphteriae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Clostridium, other than perfringens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Clostridium perfringens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Peptostreptococcus and Peptococcus | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Stenotrophomonas maltophilia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Neisseria meningitidis | 1 | 0 | 1 | 0 | 2 | 0 | 1 | 1 | 0 | 0 |
| Haemophilus, other than influenzae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Haemophilus influenzae | 2 | 2 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Capnocytophaga canimorsus | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Campylobacter species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acinetobacter | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Veillonella species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prevotella species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fusobacterium species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bacteroides, other than fragilis group | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bacteroides fragilis group | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pseudomonas, other than aeruginosa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pseudomonas aeruginosa | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 0 | 0 |
| Other enterobacter species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Yersinia pseudotuberculosis | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Yersinia enterocolitica | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Salmonella, other than Typhi or Paratyphi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Salmonella Paratyphi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Salmonella Typhi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Proteus vulgaris | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Proteus mirabilis | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Morganella morganii | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Klebsiella species | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hafnia alvei | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Enterobacter species | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| Other bacteria | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | 2 |
| Total | 40 | 30 | 37 | 45 | 32 | 31 | 33 | 47 | 38 | 42 |
| Candida albicans | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Other candida species | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| Other fungi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 |

**Table 28. Blood culture findings in all age groups, 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Escherichia coli | 2,563 | 2,650 | 2,811 | 2,986 | 3,221 | 3,471 | 3,463 | 3,876 | 4,366 | 4,532 |
| Staphylococcus aureus | 1,240 | 1,179 | 1,260 | 1,289 | 1,374 | 1,484 | 1,492 | 1,590 | 1,925 | 2,052 |
| Klebsiella species | 481 | 508 | 572 | 659 | 683 | 644 | 766 | 785 | 886 | 939 |
| Streptococcus pneumoniae | 745 | 778 | 919 | 851 | 830 | 771 | 748 | 718 | 700 | 809 |
| Staphylococcus epidermidis | 685 | 665 | 686 | 678 | 696 | 643 | 549 | 640 | 680 | 739 |
| Staphylococcus, other coagulase-negative | 310 | 353 | 373 | 357 | 342 | 354 | 311 | 448 | 548 | 633 |
| Streptococcus, other beta-haemolytic | 331 | 313 | 321 | 360 | 423 | 440 | 443 | 514 | 617 | 627 |
| Enterococcus faecalis | 309 | 338 | 311 | 343 | 341 | 386 | 408 | 401 | 458 | 457 |
| Bacteroides fragilis group | 204 | 218 | 256 | 232 | 289 | 312 | 286 | 302 | 386 | 421 |
| Pseudomonas aeruginosa | 219 | 262 | 268 | 265 | 318 | 293 | 332 | 325 | 316 | 338 |
| Enterobacter species | 186 | 184 | 210 | 215 | 260 | 255 | 276 | 282 | 259 | 327 |
| Streptococcus agalactiae | 212 | 213 | 239 | 250 | 290 | 230 | 242 | 258 | 290 | 301 |
| Streptococcus viridans group | 274 | 258 | 306 | 313 | 333 | 360 | 358 | 375 | 312 | 289 |
| Enterococcus faecium | 170 | 216 | 220 | 263 | 255 | 276 | 262 | 308 | 341 | 275 |
| Streptococcus milleri group | 133 | 119 | 128 | 120 | 129 | 146 | 145 | 190 | 256 | 274 |
| Streptococcus pyogenes | 162 | 207 | 220 | 189 | 171 | 167 | 216 | 181 | 211 | 186 |
| Proteus mirabilis | 87 | 108 | 113 | 120 | 132 | 114 | 154 | 138 | 179 | 182 |
| Citrobacter species | 70 | 56 | 90 | 90 | 109 | 87 | 121 | 122 | 135 | 143 |
| Serratia species | 49 | 56 | 78 | 65 | 82 | 92 | 90 | 115 | 103 | 132 |
| Clostridium, other than perfringens | 56 | 52 | 55 | 68 | 71 | 62 | 79 | 69 | 105 | 99 |
| Peptostreptococcus and Peptococcus | 40 | 36 | 26 | 56 | 52 | 58 | 43 | 54 | 82 | 79 |
| Bacillus | 46 | 37 | 46 | 38 | 43 | 50 | 40 | 65 | 89 | 77 |
| Clostridium perfringens | 48 | 53 | 44 | 66 | 56 | 59 | 67 | 42 | 70 | 73 |
| Fusobacterium species | 31 | 51 | 46 | 36 | 55 | 47 | 68 | 60 | 70 | 63 |
| Morganella morganii | 22 | 33 | 25 | 26 | 35 | 38 | 23 | 48 | 51 | 53 |
| Haemophilus influenzae | 32 | 54 | 44 | 46 | 40 | 64 | 80 | 47 | 57 | 52 |
| Acinetobacter | 32 | 36 | 28 | 39 | 34 | 40 | 35 | 37 | 32 | 49 |
| Enterococcus, other or unidentified | 27 | 21 | 34 | 35 | 39 | 45 | 55 | 26 | 26 | 46 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Campylobacter species | 8 | 11 | 12 | 17 | 12 | 5 | 10 | 12 | 46 | 46 |
| Listeria monocytogenes | 37 | 36 | 34 | 30 | 62 | 37 | 54 | 58 | 62 | 41 |
| Stenotrophomonas maltophilia | 18 | 18 | 22 | 22 | 23 | 13 | 16 | 27 | 24 | 36 |
| Streptococcus bovis group | 23 | 24 | 16 | 33 | 21 | 19 | 27 | 33 | 24 | 31 |
| Salmonella, other than Typhi or Paratyphi | 60 | 65 | 64 | 30 | 53 | 41 | 48 | 50 | 44 | 30 |
| Prevotella species | 21 | 16 | 25 | 28 | 28 | 29 | 23 | 21 | 28 | 28 |
| Propionibacterium species | 16 | 10 | 8 | 18 | 16 | 23 | 15 | 17 | 23 | 26 |
| Pseudomonas, other than aeruginosa | 9 | 13 | 16 | 19 | 16 | 16 | 19 | 20 | 33 | 25 |
| Capnocytophaga canimorsus | 12 | 10 | 11 | 13 | 13 | 23 | 20 | 26 | 24 | 21 |
| Proteus vulgaris | 16 | 12 | 6 | 7 | 10 | 10 | 15 | 16 | 20 | 19 |
| Neisseria meningitidis | 32 | 29 | 22 | 24 | 30 | 26 | 21 | 16 | 16 | 17 |
| Bacteroides, other than fragilis group | 7 | 8 | 13 | 23 | 9 | 15 | 19 | 19 | 18 | 17 |
| Haemophilus, other than influenzae | 7 | 4 | 5 | 1 | 3 | 4 | 14 | 14 | 10 | 14 |
| Veillonella species | 7 | 9 | 12 | 11 | 8 | 17 | 11 | 18 | 19 | 9 |
| Hafnia alvei | 3 | 7 | 11 | 13 | 8 | 3 | 10 | 7 | 6 | 9 |
| Mycobacterium species | 9 | 6 | 6 | 2 | 7 | 6 | 4 | 9 | 5 | 8 |
| Yersinia enterocolitica | 1 | 2 | 0 | 2 | 2 | 0 | 3 | 0 | 1 | 3 |
| Salmonella Paratyphi | 3 | 6 | 6 | 3 | 3 | 1 | 3 | 1 | 2 | 3 |
| Salmonella Typhi | 3 | 6 | 1 | 3 | 9 | 4 | 1 | 6 | 5 | 1 |
| Corynebacterium diphteriae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Yersinia pseudotuberculosis | 1 | 1 | 1 | 3 | 1 | 0 | 2 | 1 | 1 | 0 |
| Other bacteria | 201 | 181 | 230 | 246 | 236 | 253 | 275 | 328 | 408 | 429 |
| Total | 9,258 | 9,528 | 10,250 | 10,603 | 11,273 | 11,533 | 11,762 | 12,715 | 14,370 | 15,060 |
| Candida albicans | 113 | 112 | 126 | 105 | 154 | 140 | 128 | 145 | 129 | 121 |
| Other candida species | 46 | 57 | 69 | 71 | 68 | 85 | 72 | 106 | 89 | 96 |
| Other fungi | 7 | 11 | 10 | 6 | 4 | 7 | 3 | 6 | 3 | 3 |
| Total | 166 | 180 | 205 | 182 | 226 | 232 | 203 | 257 | 221 | 220 |

**Table 29. Cerebrospinal fluid culture findings in all age groups, 2006–2015 (no. of cases).**

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Streptococcus pneumoniae | 33 | 26 | 39 | 36 | 26 | 25 | 24 | 27 | 16 | 30 |
| Staphylococcus epidermidis | 44 | 32 | 42 | 28 | 17 | 18 | 30 | 23 | 30 | 25 |
| Staphylococcus aureus | 12 | 21 | 21 | 24 | 20 | 27 | 22 | 24 | 14 | 20 |
| Propionibacterium species | 7 | 5 | 6 | 6 | 8 | 6 | 7 | 8 | 24 | 19 |
| Staphylococcus, other coagulase-negative | 15 | 9 | 22 | 16 | 11 | 7 | 12 | 18 | 15 | 15 |
| Listeria monocytogenes | 5 | 3 | 3 | 4 | 7 | 5 | 5 | 6 | 6 | 9 |
| Streptococcus agalactiae | 9 | 13 | 5 | 7 | 13 | 3 | 5 | 3 | 9 | 8 |
| Neisseria meningitidis | 29 | 24 | 9 | 13 | 12 | 11 | 12 | 8 | 4 | 5 |
| Escherichia coli | 8 | 4 | 5 | 6 | 4 | 4 | 4 | 2 | 3 | 5 |
| Enterococcus faecalis | 8 | 9 | 4 | 4 | 5 | 3 | 5 | 0 | 2 | 3 |
| Streptococcus viridans group | 10 | 3 | 1 | 7 | 3 | 5 | 5 | 3 | 2 | 2 |
| Mycobacterium species | 0 | 1 | 3 | 1 | 1 | 2 | 2 | 0 | 1 | 2 |
| Bacillus | 7 | 4 | 4 | 0 | 0 | 2 | 3 | 0 | 1 | 2 |
| Acinetobacter | 5 | 6 | 2 | 3 | 0 | 2 | 2 | 0 | 1 | 2 |
| Serratia species | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 |
| Citrobacter species | 0 | 2 | 0 | 0 | 2 | 1 | 1 | 1 | 1 | 2 |
| Haemophilus, other than influenzae | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 |
| Pseudomonas aeruginosa | 7 | 3 | 6 | 5 | 3 | 1 | 5 | 3 | 2 | 1 |
| Enterobacter species | 2 | 3 | 9 | 4 | 2 | 3 | 6 | 3 | 2 | 1 |
| Streptococcus, other beta-haemolytic | 1 | 0 | 1 | 4 | 1 | 2 | 1 | 1 | 1 | 0 |
| Streptococcus pyogenes | 1 | 0 | 2 | 3 | 1 | 1 | 1 | 0 | 2 | 0 |
| Streptococcus milleri group | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| Streptococcus bovis group | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Enterococcus, other or unidentified | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| Enterococcus faecium | 1 | 1 | 0 | 3 | 0 | 2 | 2 | 1 | 0 | 0 |
| Clostridium, other than perfringens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Peptostreptococcus and Peptococcus | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| Stenotrophomonas maltophilia | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Haemophilus influenzae | 2 | 2 | 4 | 3 | 0 | 4 | 1 | 2 | 5 | 0 |
| Capnocytophaga canimorsus | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| Campylobacter species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Bacteroides, other than fragilis group | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Bacteroides fragilis group | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pseudomonas, other than aeruginosa | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| Salmonella, other than Typhi or Paratyphi | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Proteus mirabilis | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| Morganella morganii | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Klebsiella species | 2 | 1 | 5 | 4 | 1 | 2 | 1 | 1 | 5 | 0 |
| Other bacteria | 4 | 3 | 4 | 6 | 2 | 1 | 2 | 4 | 9 | 5 |
| Total | 216 | 181 | 203 | 194 | 141 | 145 | 160 | 139 | 160 | 159 |
| Other candida species | 2 | 3 | 0 | 2 | 1 | 1 | 1 | 0 | 2 | 2 |
| Candida albicans | 0 | 1 | 1 | 1 | 0 | 0 | 3 | 0 | 0 | 1 |
| Total | 2 | 4 | 1 | 3 | 1 | 1 | 4 | 0 | 2 | 3 |

# Authors

## Respiratory infections

**Adenovirus**
*Niina Ikonen, Outi Lyytikäinen (THL)*

**Influenza A and B**
*Niina Ikonen, Outi Lyytikäinen, Hanna Nohynek (THL)*

**Parainfluenza**
*Niina Ikonen, Outi Lyytikäinen (THL)*

**Rhinovirus**
*Carita Savolainen-Kopra, Outi Lyytikäinen (THL)*

**RSV**
*Niina Ikonen, Outi Lyytikäinen (THL)*

**Enterovirus**
*Soile Blomqvist (THL)*

**Whooping cough**
*Jussi Sane, Hanna Nohynek (THL)*

**Legionella**
*Topi Turunen, Jaana Kusnetsov, Silja Mentula, Sari Jaakola, Outi Lyytikäinen (THL)*

**Mycoplasm**
*Mirja Puolakkainen (University of Helsinki)*

**Chlamydial pneumonia**
*Mirja Puolakkainen (University of Helsinki)*

## Gastrointestinal infections

**Food-borne epidemics**
*Ruska Rimhanen-Finne, Saara Salmenlinna (THL)*

**Clostridium difficile**
*Silja Mentula, Outi Lyytikäinen (THL)*

**EHEC**
*Sari Huusko, Ruska Rimhanen-Finne, Ulla-Maija Nakari (THL)*

**Campylobacter**
*Ruska Rimhanen-Finne, Ulla-Maija Nakari (THL)*

**Listeria**
*Ruska Rimhanen-Finne, Saara Salmenlinna (THL)*

**Salmonella**
*Satu Murtopuro, Ruska Rimhanen-Finne, Aino Kyyhkynen, Saara Salmenlinna (THL)*

**Shigella**
*Satu Murtopuro, Ruska Rimhanen-Finne, Saara Salmenlinna, Aino Kyyhkynen (THL)*

**Yersinia**
*Huusko Sari, Ruska Rimhanen-Finne, Saara Salmenlinna, Aino Kyyhkynen (THL)*

**Norovirus**
*Sari Huusko, Ruska Rimhanen-Finne, Haider Al-Hello, Jaana Pirhonen (THL),*

**Rotavirus**
*Topi Turunen, Tuija Leino, Jaana Pirhonen, Haider Al-Hello, (THL)*

## Hepatitis

**Hepatitis A**
*Ruska Rimhanen-Finne, Tuija Leino, Mia Kontio (THL)*

**Hepatitis B**
*Markku Kuusi, Tuija Leino, Henrikki Brummer-Korvenkontio, Kirsi Liitsola (THL)*

**Hepatitis C**
*Markku Kuusi, Henrikki Brummer-Korvenkontio, Kirsi Liitsola (THL)*

## Sexually transmitted diseases

**Chlamydia**
*Kirsi Liitsola (THL)*
*Eija Hiltunen-Back (HUS)*

**Gonorrhoea**
*Kirsi Liitsola (THL)*
*Eija Hiltunen-Back (HUS)*

**Syphilis**
*Kirsi Liitsola (THL)*
*Eija Hiltunen-Back (HUS)*

**HIV and AIDS**
*Henrikki Brummer-Korvenkontio, Kirsi Liitsola (THL)*

## Antimicrobial resistance

**MRSA**
*Outi Lyytikäinen, Laura Lindholm, Hanne-Leena Hyyryläinen (THL)*

**VRE**
*Outi Lyytikäinen, Hanne-Leena Hyyryläinen, Laura Lindholm (THL)*

**ESBL**
*Outi Lyytikäinen, Jari Jalava, Monica Österblad (THL)*

**CPE**
*Outi Lyytikäinen, Jari Jalava, Monica Österblad (THL)*

## Tuberculosis

**Tuberculosis**
*Hanna Soini, Outi Lyytikäinen, Hanna Nohynek, Marjo Haanperä (THL)*
*Tuula Vasankari (Filha)*

## Other infections

**Invasive pneumococcal disease**
*Maija Toropainen, Jari Jalava, Lotta Siira, Arto Palmu, Pekka Nuorti (THL)*

**Haemophilus**
*Maija Toropainen, Tuija Leino (THL)*

**Meningococcus**
*Maija Toropainen, Markku Kuusi, Anni Vainio, Hanna Nohynek (THL)*

**MMR diseases (measles, mumps, rubella)**
*Topi Turunen, Tuija Leino, Mia Kontio (THL)*

**Varicella virus**
*Topi Turunen, Tuija Leino (THL)*

**Borrelia**
*Jussi Sane (THL)*

**Tick-borne encephalitis (TBE)**
*Jussi Sane, Tuija Leino, Pirjo Turtiainen (THL)*
*Olli Vapalahti (University of Helsinki)*

**Puumala virus**
*Jussi Sane (THL)*

**Pogosta disease**
*Jussi Sane (THL)*

**Tularemia**
*Jussi Sane (THL)*

**Rabies**
*Satu Murtopuro, Ruska Rimhanen-Finne, Eeva Pekkanen (THL)*

**Diphtheria (Corynebacterium diphtheriae)**
*Jussi Sane, Taneli Puumalainen*

**Relapsing fever (Borrelia recurrentis)**
*Jussi Sane*

## Travel-related infections

**Malaria**
*Heli Siikamäki (HUS)*

**Dengue fever**
*Jussi Sane, Eeva Pekkanen (THL)*

**Chikungunya**
*Jussi Sane, Eeva Pekkanen (THL)*

**Other travel-related infections**
*Eeva Pekkanen (THL)*

**Blood and cerebrospinal fluid findings in children**
*Topi Turunen, Outi Lyytikäinen (THL)*

**Blood and cerebrospinal fluid findings in adults**
*Topi Turunen, Outi Lyytikäinen (THL)*

**Group A streptococcus**
*Hanne-Leena Hyyryläinen, Kati Räisänen (THL)*